Assessing the Impact of a Dynamic Chronic Care Registry on the Quality of Care

Final Report

Assessing the Impact of a Dynamic Chronic Care Registry on the Quality of Care

Prepared for:
Agency for Healthcare Research and Quality
U.S. Department of Health and Human Services
540 Gaither Road
Rockville, MD 20850
www.ahrq.gov

Contract No. HHSA290200600020

Prepared by:
Denver Health

Authors:
Henry H. Fischer, M.D. – Principal Investigator
Thomas D. MacKenzie, M.D., M.S.P.H. – Co-Principal Investigator
Andrew W. Steele, M.D., M.P.H., M.Sc. – Co-Principal Investigator
Sheri L. Eisert, Ph.D. – Co-Principal Investigator
Susan L. Moore, M.S.P.H. – Investigator
M. Josh Durfee, M.S.P.H. – Project Manager

This document is in the public domain and may be used and reprinted with permission except those copyrighted materials that are clearly noted in the document. Further reproduction of those copyrighted materials is prohibited without the specific permission of copyright holders.

Preface

This project was funded as an Accelerating Change and Transformation in Organizations and Networks (ACTION) task order contract. ACTION is a 5-year implementation model of field-based research that fosters public–private collaboration in rapid-cycle, applied studies. ACTION promotes innovation in health care delivery by accelerating the development, implementation, diffusion, and uptake of demand-driven and evidence-based products, tools, strategies, and findings. ACTION also develops and diffuses scientific evidence about what does and does not work to improve health care delivery systems. It provides an impressive cadre of delivery-affiliated researchers and sites with a means of testing the application and uptake of research knowledge. With a goal of turning research into practice, ACTION links many of the Nation's largest health care systems with its top health services researchers. For more information about this initiative, go to http://www.ahrq.gov/research/action.htm.

This project was one of seven task order contracts awarded under the *Improving Quality through Health IT: Testing the Feasibility and Assessing the Impact of Using Existing Health IT Infrastructure for Better Care Delivery* request for task order (RFTO). The goal of this RFTO was to fund projects that used implemented health IT system functionality to improve care delivery. Of particular interest were projects that demonstrated how health IT can be used to improve decision support, automate quality measurement, improve high-risk transitions across care settings, reduce error or harm, and support system and workflow design, new care models, team-based care, or patient-centered care.

Contents

Tables

Figures

Appendixes

Executive Summary

Purpose/Objectives

The primary objective of this task order was to improve quality of care provided to adult diabetic patients currently receiving care within an urban safety net system through the use of information from an integrated diabetes registry. This registry was used to address the following objectives:

- Distribute an individualized patient report card to (i) the patient's home on a quarterly basis and (ii) the patient at the time of each of their primary care visits.
- Develop and distribute to providers both standard report cards at all eight clinics and enhanced report cards at four of the eight clinics on a quarterly basis.
- Develop a point-of-care interface to the diabetes registry data and make it available to the clinical team at the point of care.
- Evaluate the effects of this three-pronged approach on process, quality, cost and satisfaction, using both quantitative and qualitative measures of assessment.
- Generalize the application of an integrated diabetes registry to other chronic diseases and to other health care systems.

Background

A disease registry is one type of clinical information system that has been proven effective in supporting new models for delivering chronic care,[1] as such is an integral part of the Chronic Care Model (CCM)[2] and important in improving primary care for patients with chronic illness.[3] By tracking patient information, a disease registry helps physicians and other members of the care team to identify and reach out to patients with gaps in care or with suboptimal quality indicators. These registries can also be used to prompt providers through point-of-care alerts to ensure that appropriate and timely care is provided during patient visits.[4] With the increased sophistication and integration of information systems, computerized disease registries are being used to improve the quality of care both at the point where care is delivered and in between visits. The work presented here describes how a diabetes registry at an urban safety-net was used to support more sophisticated care delivery and to improve quality of care for patients with diabetes. The lessons learned may be pertinent to other chronic diseases that can be tracked through registries.

Methods

We conducted a randomized, controlled trial using a diabetes registry with 5,457 adults with diabetes at eight federally-qualified community health centers for three separate interventions. Quantitative analyses were conducted using expert-recommended glycemic (percent of patients with HgA1c < 7), lipid (percent of patients with LDL < 100 mg/dl), and blood pressure (BP < 130/80 mmHg) intermediate outcomes and process outcomes of labs for HgA1c and LDL and BP taken in the last year:

Mailed Patient Report Cards

Half of the patients received report card mailings quarterly. Qualitative assessment of report card utility and patient and provider satisfaction was conducted through analysis of two quarters of mailed patient surveys.

Point-of-care Patient Report Cards and Provider Performance Feedback

Patients at four of eight clinics received report cards at every clinic visit. Providers at 4 of 8 clinics received quarterly performance feedback with targeted patient-level data. Mid- and post-intervention provider interviews were conducted for qualitative analyses.

Point-of-care Reminders

Point-of-care reminders were evaluated for a single pilot site in August 2008 through December 2008. A focus group of the providers at that site was conducted.

Results

Mailed Patient Report Cards

Many providers and the majority of patients perceived the patient report card as being an effective tool. However, patient report card mailings did not improve process outcomes.

Point-of-care Patient Report Cards and Provider Performance Feedback

On-site distribution did not improve intermediate outcomes. However, both patients and providers expressed satisfaction with its potential to motivate behavioral change. Clinics with patient-level provider performance feedback achieved better glycemic control ($p < 0.01$). Provider reaction to performance feedback was mixed, with some citing frustration with the lack of both time and ancillary resources.

It cost an estimated $45,928 to perform the enhanced provider report cards. This translates to $901 per additional patient controlled for HgA1c.

Point-of-care Reminders

Utilization of point-of-care reminders was far less than anticipated. Providers at the pilot site accessed the reminders only nine total times. The point-of-care reminder tool was perceived as an efficient means for collecting diabetes-related patient information together in one place, thus potentially providing easier access to the collected data for the provider. However, access to the report itself was found to be much more problematic.

Limitations

Concomitant quality improvement efforts make it challenging to isolate the effects of an intervention implemented across a number of outlying clinics.

Lessons Learned/Unintended Consequences

Several themes and lessons have emerged from the program implementation and analyses:

- Provider buy-in is mandatory for success.
- Qualitative analysis is key in order to identify noninterventional quality improvement efforts and other factors that have the potential to influence the implementation and outcomes of an intervention in order to incorporate their effects into the final analysis.
- One challenge of implementing a control group of providers or clinics is the perception at the nonintervention sites that they are being prevented from using useful intervention tools (e.g., the patient report card) and that this detracts from the quality of their patient care.
- However, studying the impact of this type of intervention is invaluable as it provides evidence as to how to best allocate resources. For instance, patient report card mailings are fairly resource intensive yet, unexpectedly, did not impact process outcomes. On the other hand, on-site printable patient report cards generate a useful and effective tool for providers and patients.
- When automating care delivery using a large chronic disease registry, it is paramount to best ensure the quality of the data of the registry. Our largest concern was dissemination of diabetes report cards to patients incorrectly labeled with diabetes (through an incorrect ICD-9 code). "Cleaning-up" of the registry prior to randomization through provider-level manual review of patient lists was effective.
- Implementing an intervention that involves point-of-care computer-generated tools requires frequent contact with the sites to rapidly detect and problem-solve technological glitches (intermittent printing problems in the initial stages in our case).
- Qualitative analysis uncovers important provider and patient attitudes towards the interventions. For instance, providers respond to performance feedback and improve the quality of care they deliver. However, providers note that (i) the provider-level performance comparison fosters competition and (ii) more support, such as case management, is needed to assist providers with patient-level feedback (the enhanced provider report card).
- Mailed patient report cards may have the unintended consequence of deterring people who are not doing well on their blood pressure indicators from coming in for a visit.
- Although the on-site printable provider report cards did not improve clinical outcomes, both patients and providers expressed satisfaction with its potential to motivate behavioral change.
- We can automate a diabetes registry and improve care by delivering targeted patient-specific data.

- It is difficult to make overall assessments of diabetes care absent a single variable which indicates a combination of levels of glycemic, hypertensive, and cholesterol control.

Recommendations

- When migrating a registry into the data warehouse allow for ample time. We allotted 6 months and had previous experience in such transitions. This seemed to be about the correct amount of time.
- When providing tools intended to improve patient care, try to provide support in the form of suggestions and guidance without orders and mandates.
- Use a mixed methods quantitative/qualitative approach to research and analysis for complete understanding of how well the program is working/not working.
- If the goal is to improve the process outcomes of increased preventive care visits, we recommend the redistribution of resources away from patient mailings.
- Ensure provider buy-in for any intervention to be implemented. Success is absolutely dependent on this buy-in.
- We believe an alternative model worth exploring is a centralized "Health Status Center" which a patient could access at any time to facilitate lab and blood pressure tests, health care maintenance, and other recommended care, such as referrals to ophthalmology or podiatry.
- Additionally, the Health Status Center would proactively reach out to patients and bring attention to health care needs by communicating with patients through their preferred modalities of communication, such as direct mail, phone calls, text messaging, and/or email.
- Given the positive qualitative feedback and the automation that facilitated on-site printable patient report cards with minimal resource utilization, we recommend it despite inconsistency with quantitative outcomes.
- Even though the patient report card intervention did not significantly improve patient clinical outcomes, patient satisfaction with the patient report cards should also be considered a positive result related to provider/patient communication.
- Develop a summary diabetic health outcome measure that combines and weights of the three intermediate outcomes of primary interest in diabetic research: HbA1c, blood pressure, and lipid control. This would allow for the ability to conduct comparative effectiveness analysis regarding the impact of interventions on diabetic health outcomes where the "whole is greater than the sum of the parts."

Purpose/Objectives

The primary objective of this task order was to improve quality of care provided to adult diabetic patients currently receiving care within an urban safety net system through the use of information from an integrated diabetes registry.

This registry was used to address the following objectives:

1. Distribute a patient report card (Appendix A) to (i) the patient's home on a quarterly basis and (ii) the patient at the time of each of their primary care visits. The patient report card was tailored to the individual patient including intermediate outcomes at their most recent visit and was intended to increase the patient's role in managing his/her own care.
2. Develop and distribute to providers both standard report cards at all eight clinics and enhanced report cards at four of the eight clinics on a quarterly basis. The enhanced provider report card was the same as the standard provider report card but included an additional list of up to 10 patients who met certain preset criteria. These criteria are explained more fully in the methods section of this report.
3. Develop a point-of-care interface to the diabetes registry data, where this interface was intended to be used by the clinical team at the point of care to improve adherence to guideline-based care. This arm of the intervention was applied to a single pilot site to assess its utility.
4. Evaluate the effects of this three-pronged approach on process, quality, cost and satisfaction, using both quantitative and qualitative methods of assessment. The results of these analyses are included in the results section of this report.
5. Generalize the application of an integrated diabetes registry to other chronic diseases and to other health care systems.

Background

   This section is separated into two parts. The first gives a brief background of the literature for diabetes and the use of disease registries for chronic disease management and the second gives a background of DH's existing infrastructure at the onset of this project.

Literature Review

   Diabetes prevalence is rising at an epidemic pace worldwide, with associated morbidity and costs that significantly impact health care systems. In the United States over 20 million persons have been diagnosed with diabetes, a number that will increase to over 30 million by the year 2030 at the current rate.[5,6] Estimates of diabetes care costs rose from $130 billion in 2002 to $174 billion in 2007 and are projected to reach $192 billion by 2020.[5,7] Approximately one-third of these costs are attributed to vascular complications caused by diabetes.[5] Numerous prospective interventional studies demonstrate that improved intermediate outcome performance can delay or prevent these complications.[8,9] These studies provide the basis for diabetes care targets recommended by the American Diabetes Association,[10] the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure,[11] and the National Cholesterol Education Program.[12]
   Recent literature reviews on the impact of diabetes disease management strategies conclude that most interventions improve process outcomes such as regular laboratory testing, but do not affect clinically important intermediate outcomes, such as performance on glycemic, lipid, and blood pressure targets. The most effective interventions are targeted and utilize case management, patient self-management, and/or expansion of clinic team member roles among their strategies.[13-18] One key component to chronic disease interventions is utilization of a disease registry, which enables health care teams to identify and contact patients with gaps in care or suboptimal quality indicators. A disease registry is an essential element of new models for chronic disease management, such as the Chronic Care Model.[1-3]
   Most studies of diabetes self-management that show improved clinical outcome performance involve multiple, time-intensive educational sessions in a group format.[19-21] Performance increases with contact time and the effect extinguishes with cessation of the interventions.[21] Given limited resources, pressures for increased productivity, and expanding numbers of quality measures in the primary care setting, it is important to determine whether this alternative model for promotion of patient self-management can affect important clinical outcomes.

Existing Infrastructure at Denver Health

   This section provides a background of the existing infrastructure at the time that this project started and how that infrastructure was improved in order to complete all the interventions. This is intended as a resource for outside organizations to gauge whether they are suitably positioned to replicate this intervention or some subset of the intervention.
   At the onset of this project in the fall of 2007, the DH diabetes registry included 7,187 patients with recorded visits from December 2005 through April 2007. This number had fluctuated between 7,000 and 7,300 since June of 2006, as patients moved on and off the registry if they became inactive or deceased. Diabetic patients included in the registry are defined as

those patients who have been seen in the primary care setting at least once in 18 months and who have been assigned at least one ICD-9 diagnosis code for diabetes (inpatient or outpatient, primary or secondary). Appendix B includes a list of the variables included in the database of the diabetes registry. Using the provider identifier, patient information can be aggregated for the patients seen by each primary care provider. This aggregated provider information includes, but is not limited to:

- Summary of demographics and lab test results.
- Summary of preventive care.
- Number of HbA1c or LDL labs performed within a chosen number of days.
- Last LDL or A1c result over a chosen threshold.
- Number of foot, eye, and dental exams in a chosen time-period.

Prior to this project, the registry resided as a stand-alone Microsoft® Access database, allowing for the creation of summary reports based on a range of values selected by the user. Appendix B also depicts the screens by which reports could be generated from the registry at the summary clinic level, the single-clinic level, and the provider level. Reports could also be generated that included lists of patients who met criteria such as having key lab results above a certain threshold value. The registry was "quasi-dynamic" in that the patient list and patient data were refreshed weekly. Each week patients who last had a DH visit more than 18 months ago were removed from the registry while new diabetic patients and existing patients with new diagnoses of diabetes in the previous week were added to the registry. At the time each new patient was added to the registry, all the relevant information related to that patient was also transferred into the registry, including items such as laboratory results, recorded vital signs, and encounter-level data. This merging of information is possible at DH since all patient data can be linked through a unique patient identifier. Reports were generated based on outcomes defined by the National Health Disparities Collaborative and the Bureau of Primary Health Care[22] as "areas of focus" and as recommendations for care by the American Diabetes Association.[23]

The diabetes registry was checked and updated for quality purposes on a weekly basis. This process included data quality checks generated by database queries as well as visual confirmation to make sure the update process had finished completely and successfully. Clinic staff also identified invalid information in the diabetes registry when contacting the patient using registry records or when reviewing the medical record through the diabetes registry. Clinic staff also reviewed patient lists and identify deceased patients, incorrectly-diagnosed patients, and patients that no longer seek care at DH. The clinics then notified the data manager of the registry to remove the patient from the registry. While this mechanism for housing, updating, and querying the diabetes registry was robust and of a high quality, it did have some limitations. The ability to most effectively identify patients and track relevant outcomes often required the manipulation of multiple data sources and detailed, on-demand reporting for care providers. Even though the patient information could be retrieved from these multiple sources using a unique patient identifier, it was "hands-on" and could be labor intensive, especially when creating customized reports.

In order to improve the quality, efficiency, performance and patient-centeredness of querying and reporting from registries within DH, as part of this project the Information Technology (IT) department transitioned the diabetes registry to the data warehouse. An overview of the old and new plan for utilizing the diabetes registry is illustrated in Figure 1. The diabetes registry (I) in

its preproject form was robust, of high quality and secure, updated weekly, but resident on a single computer (II) at each clinic site and subject to the limitations that result from less-than-full integration. Updating and migrating the diabetes registry to the data warehouse (III) allows for physicians to directly access customized reports that are automatically generated and refreshed into Portable Document Format (PDF) on a secure Web Portal (IV), using their own password protected computers (V). Multiple levels of security ensure that patient records continue to be safe and private. Other advantages to accessing and updating the registry through the data warehouse include automated creation of mailing labels for patient report cards, more automated updating of the clinical data, and a centralized location for patient data. Lastly, with further enhancement, housing the registry in the data warehouse will allow for the creation of composite data elements from multiple sources (e.g., a flag that represents poor medication adherence AND poor blood pressure control over multiple visits).

Figure 1. Old (II) and new (III-V) mechanisms for utilizing the Diabetes Registry
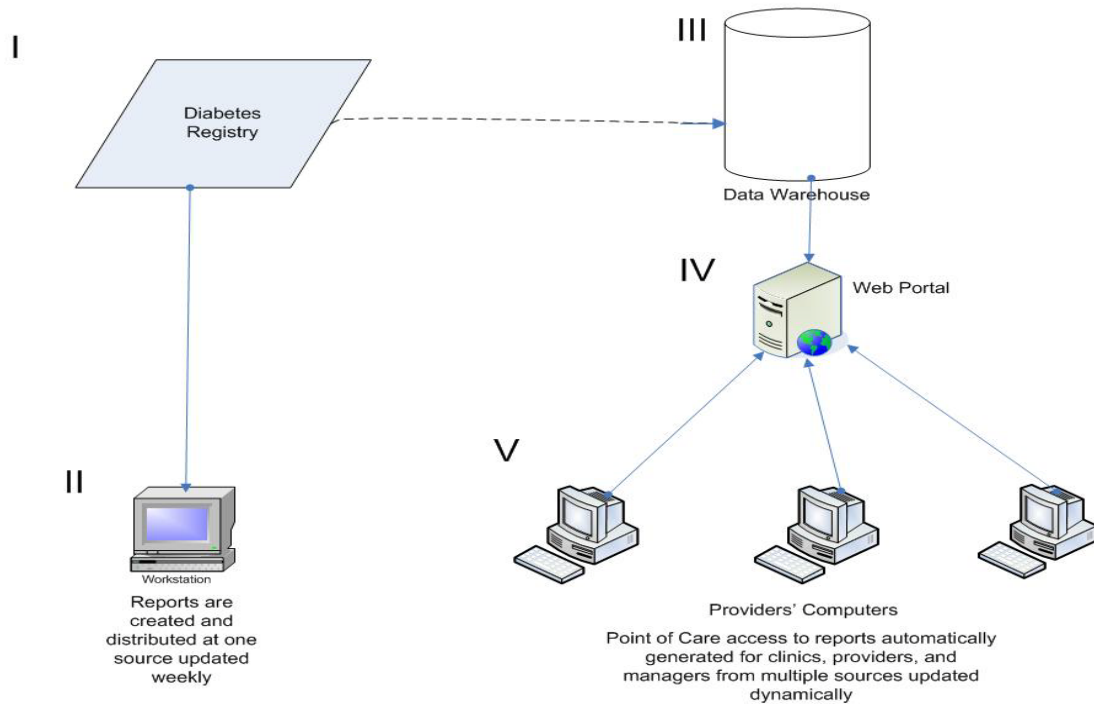
DH's data warehouse includes a dynamic patient registry of all primary care patients, with integrated administrative and clinical data from more than eight data sources, enabling patient identification and outcome tracking within a stable, secure environment (SQL 2000 tables). Additionally, DH had experience in moving stand-alone database registries into the data warehouse and adding them into the comprehensive information system prior to this project, such as the colorectal screening registry. Current colorectal screening status is now based off of procedure codes for an endoscopy, laboratory data for fecal occult blood testing, and electronic medical encounter data documenting the dates of any relevant off-site procedures. A hypertension registry was also in the process of being added to the data warehouse at the inception of this project, allowing for the development of additional specific process-based

experience in translating an existing disease registry into the data warehouse. With the transfer of these registries to the data warehouse, the resource-intensive monthly updating of the stand-alone databases has also been greatly reduced through the utilization of extensive SQL coding and the automated scheduling features available through the data warehouse.

The DH data warehouse was launched in 1997 with an installation of a Siemens Medical System (Appendix C). The many ancillary services housed in this single location include lab, radiology, pharmacy, scheduling, and pathology. The database has been designed and built to accommodate rapid growth over the next few years and currently consumes approximately 500 Gb of the 2 terabytes of disk space allocated. The server utilizes 8 Hyper-Threaded processors (for a logical processor count of 16) along with 8 Gb of RAM. Along with the Web Portal, information in the data warehouse can be accessed through Crystal Reports, Executive View, and MS Analysis Services, as well as by using other tools.

While the transition of the diabetes registry to the data warehouse was not necessary for the DH IT system to be used to support the delivery of high quality health care, it will further improve the quality of care in the same ways that have been realized with the successful migration of the colorectal screening registry to the data warehouse. The combined IT and quality team at DH determined that the movement of the diabetes registry was one of many operational priorities. The diabetes registry migrated to the data warehouse in April 2008.

Methods

Description of Interventions

We conducted a prospective, randomized, controlled trial using a diabetes registry with 5,457 adults with diabetes at eight federally-qualified community health centers for three separate interventions:

1. Distribute a patient report card to (i) the patient's home on a quarterly basis and (ii) the patient at the time of each of their primary care visits. The patient report cards were tailored to the individual patient and increased the patient's role in managing his/her own care. Twelve monthly report cards were sent. The report card that was part of the primary care visit was printed out at the time of registration for diabetic patients at the four randomly selected clinic sites.
2. Develop and distribute both standard and enhanced provider report cards on a quarterly basis to the primary care providers regarding the quality of care they are providing to their diabetic patients in eight community health centers. The enhanced provider report card was the same as the standard provider report card but included an additional list of up to 10 patients who met certain preset high risk criteria (see table 2). Providers at all eight clinics received the standard provider report card. The providers at the four intervention clinics also received four quarterly enhanced provider report cards.
3. Develop a point-of-care interface to the diabetes registry data. This interface was used by the clinical team at the point of care to improve adherence to guideline-based care. This point-of-care interface was used at a single pilot site.

The interventions took place over 13 months at eight federally qualified community health care centers within DH, an urban safety-net health care system, ending January 1, 2009. Randomization for the mailed patient report cards took place at the patient level across the entire diabetes registry. Randomization took place at the clinic level in a 2x2 factorial design for the on-site printable report card and the enhanced provider report card arms, stratified by clinic size. A given clinic was randomized to (i) automated distribution of the on-site printable report card or no distribution of the on-site printable report card and (ii) distribution of either a standard provider report card or an enhanced provider report card, which also included targeted patient level data. Of our eight clinics, four are relatively small and four are relatively large in size. We randomly assigned one large and one small clinic to each of the four design arms. The Colorado Multiple Institutional Review Board (COMIRB) approved this study prior to implementation. Figure 2 provides a timeline for implementation and assessment of the three interventions.

Figure 2. Project timeline

Implementation and Intervention Timeline
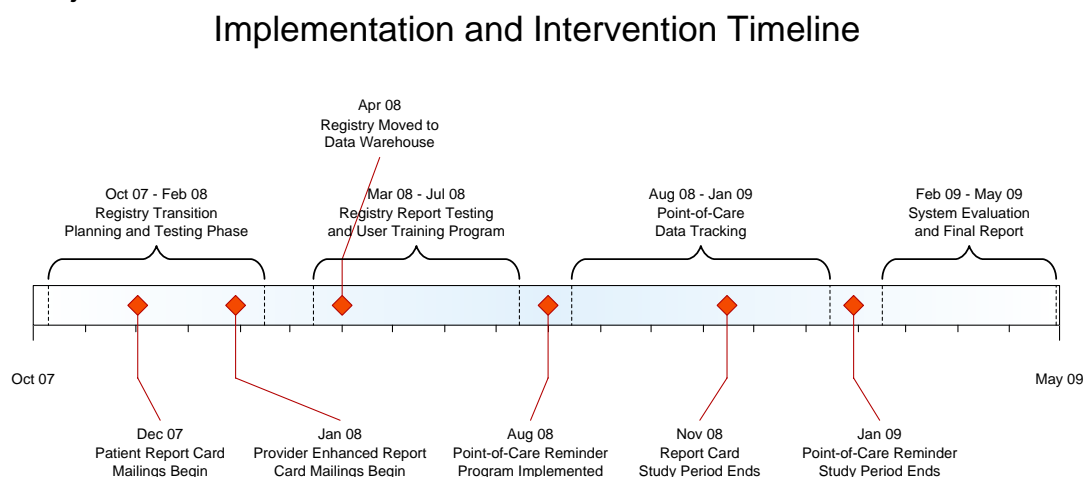
The clinical and process outcomes are quantitatively and qualitatively assessed for each of the three interventions in the results section. Table 1 describes the clinical outcomes assessed for each intervention, and Appendix D (patient report card surveys) and E (provider interview guide) are the survey and interview instruments used in the qualitative assessment. The results from the patient report card survey were used in the qualitative assessment of the first intervention. The provider guide was used in the qualitative, interview-based assessment of the second intervention, while a second and separate set of unstructured interviews were conducted as part of the qualitative assessment of the third intervention.

Table 1. Overview of evaluation plan for clinical outcomes

Intervention prong	Intervention group Description	Intervention group N	Intervention Period	Clinical and Process outcomes being assessed	Programmatic Costs? Assessment of resources used to/for:
1. Patient Report Cards	A. Mailings: One-half of all diabetics on registry that fulfill inclusion criteria across all clinics. B: Point of Care distribution: Diabetic patients at Eastside, La Casa, Montbello, and Park Hill clinics.	Mailings 2,729 Point of care 2,316	Quarterly for a year beginning in December 2007	1. Average HbA1c 2. HbA1c < 7% 3. HbA1c Testing 4. Lipid Profile Testing 5. LDL < 100 mg/dl 6. BP Testing 7. Last Blood Pressure < 130/80 mm HG	• Monitor and quality control of registry. • Print and prepare mailings. • Postage. • IT development specific to the patient report card.

Table1. Overview of evaluation plan for clinical outcomes (continued)

Intervention prong	Intervention group Description	Intervention group N	Intervention Period	Clinical and Process outcomes being assessed	Programmatic Costs? Assessment of resources used to/for:
2. on-site printable and Enhanced Provider Report Cards	Patients who fit inclusion criteria at Westside Clinic, Eastside Clinic, Westwood and Montbello	1,131	Quarterly for a year beginning in January, 2008	HbA1c <7% LDL < 100 mg/dl Last BP < 130/80 mm HG	•Create the enhanced form •Disseminate provider report card •Evaluate providers' time in contacting patients listed on enhanced report card •IT development specific to the providers' enhanced form
3. Point-of-service Interface	Patients at a single pilot site	N/A	August 2008 through January 2009	1. Frequency of use of point-of-care interface	•Evaluate providers' time in using point-of-service interface •IT development specific to the point-of-service interface

Mailed Patient Report Cards

Patient report cards were mailed to the 2,729 patients in the intervention group on a quarterly basis. Each month, 1/3 of the 2,729 patients were mailed report cards so that over a 3-month period all 2,729 patients received a report card. The number of patients actually mailed the report cards slightly decreased each quarter as people dropped off the registry because they have "moved or gone elsewhere" (MOGE). Reasons for categorizing patients as MOGE included verification by their primary care provider that they are deceased or are no longer patients at Denver Health. This staggered mailing approach was used so that resource demand could be leveled. During the next quarter, the same mailing process repeats, resulting in patients receiving one report card each quarter. In addition to the patient report cards, a self-addressed, postage-paid survey was included with the second quarter and fourth quarter mailings to the patients in the intervention group.

The mailed patient report cards were expected to affect process outcomes by triggering visits while the report cards distributed at the point of care were expected to improve intermediate health outcomes. The assessment reflects these expected improvements by having both process and health outcome components.

Process Outcomes. The patient report cards were mailed to the address listed for the most recent visit. Due to the high mobility of the safety net patient population we expected a relatively high mail return rate. The impact of the patient report card on cost, quality and satisfaction will then be determined for those patients where the mailing had been accepted and not returned. Process measures for this intervention include—

- # Mailed
- Mail return rate

Clinical Outcomes. The additional process outcomes of HgA1c Testing, BP Testing, and Lipid Profile Testing are the percentage of patients who had at least one test in the previous one year period. The clinical outcome of HgA1c < 7 is the percentage of patients with an HgA1c less than seven and is limited to those patients who had an HgA1c checked in the previous year. The outcome of LDL < 100mg/dl is the percentage of patients with an LDL below 100 and is limited to patients tested in the previous year. The outcome of last blood pressure < 130 systolic blood pressure over 80 diastolic blood pressure must be lower than the threshold on both and is limited to patients tested in the previous year.

For all diabetics in the registry, outcome data were collected at baseline, 6 months and 12 months for both the treatment and control groups, which allowed for interim evaluation and process adjustment as well as the potential identification of any lasting behavioral change. The analyses adjust for differences in age, race/ethnicity, gender, degree of illness, and baseline levels for each outcome variable and included generalized estimated equations (GEE) to account for the within-subject correlation of repeated measures by individual patients. Patients who had moved or gone elsewhere (MOGE) were analyzed according to an intention-to-treat threshold, as if they received the patient report cards and were still active patients at Denver Health. All analyses were performed using SAS Enterprise Guide software version 9.1 (Cary, NC).

The Chronic Illness and Disability Payment System (CDPS) was the risk adjustment method used to determine whether there were differences in the degree of illness between the control and intervention groups. CDPS uses a diversity of ICD-9-CM codes to group and weight diagnoses for chronic and disabling diseases.

Patient Satisfaction and Report Card Utility. In order to evaluate patient satisfaction with the mailed report cards and to qualitatively assess intervention effectiveness, the second and fourth report card mailings also included a one-page survey, developed by the project team and approved by COMIRB (Appendix A). Surveys were designed to be self-administered, included both fixed-response and unstructured questions, and were printed in both English and Spanish.

A self-addressed, postage-paid envelope was included to facilitate response; however, neither reminders such as followup mailings or telephone calls nor additional incentives for participation were offered. This approach was selected in order to most reliably represent results from patient satisfaction assessments if conducted on an ongoing, sustainable basis in a safety net system with limited financial resources.

Survey data were recorded in a Microsoft® Access database designed for the project, with each survey response comprising one database record. The database was stored on a server to which access was secured by network user account-assigned permissions. Each survey response was assigned a unique ID based on the order in which the response was received in the mail. Survey responses were entered into the database on a daily basis, on the same day that they were received by the project team. Any identifying data written by the respondent on the survey was redacted with a permanent black marker, after which the received surveys were stored in a secure filing cabinet.

Spanish-language unstructured responses received were professionally translated. Translations were recorded together with the original Spanish-language text in the database record for each survey response.

Unstructured responses were generated as a results set from the database and subjected to content analysis. An open coding process was used to develop heuristic codes from themes and patterns that emerged during analysis. The initial codes were then reexamined in context and

refined into an objective code set, which was used in a final inductive analysis of the survey responses.

Cost Analysis. The evaluation of programmatic costs related to the mailed report cards include the resources related to—

- Creating the patient mailing lists and information.
- Quality control of the diabetes registry data.
- Printing and preparing mailings.
- Postage.
- Supporting the IT development specific to creating the patient report card.

Enhanced Provider Report Cards

Clinical Outcomes. All providers receive either a standard or an enhanced report card as part of the normal process of care. The standard report card is generated from the diabetes registry and has been sent to all clinicians as part of usual diabetes care; it includes:

- The provider's performance across his/her patient panel on intermediate outcomes (including average HgA1c, percentage with HgA1c < 7.0, percentage with LDL < 100, percent with blood pressure < 130/80, and percentage with a self-management goal).
- The mean outcome performance across all providers at that clinic site.
- The best provider performance on each of the outcomes at that clinic site.
- The mean outcome performance across all clinic sites.

The enhanced report card included the same information as the standard report card, plus a list of up to 10 high risk diabetic patients who meet certain preset criteria. Criteria used to generate the list changed quarterly and are shown in Table 2.

Table 2. Enhanced provider report cards

Quarter	Date of dissemination	Inclusion Criteria
1	January 10, 2008	HgA1c levels between 7 and 11 and have not checked in at least 2 months
2	April 16, 2008	LDL cholesterol more than 99 and not checked in at least 2 months
3	July 23, 2008	Systolic blood pressure greater than 145 OR Diastolic blood pressure greater than 90 and not checked in at least 2 months
4	October 22, 2008	Patients who achieve the thresholds of any of the previously set criteria and have not been on any of the previous lists.

Originally we had intended to analyze the intervention group to include all patients who were on a provider's enhanced report card during the year of distribution. We altered this analysis to include all patients at clinics where enhanced report cards were distributed, regardless of whether they were themselves on such a list. This better fit the intention to treat model that we had originally planned and any error implicit in this design would be toward the mean. As with the patient report card analyses, baseline values that were observed to be significantly different

between intervention and control groups prior to the intervention are controlled for via multivariate regression.

Since the on-site patient and providers' enhanced report card interventions are implemented simultaneously, advantages in one intervention could affect advantages in the other. For this reason, a 2x2 factorial design was used for analysis. In order to differentiate advantages of care associated with the patient report card versus those advantages associated with the providers' enhanced report card, analyses are done separating the patients into the four possible categories of intervention and control group. Since it was expected that patient report cards distributed at the clinics would be more likely to impact intermediate health outcomes than those mailed, these analyses looking at the interaction of the patient report cards and the enhanced provider report cards focus on the patient report cards distributed at the clinics. The four categories include:

1. Patients whose report cards **were available** at the point of care and whose primary physician was at clinic with provider's enhanced report cards.
2. Patients whose report cards **were available** at the point of care and whose primary physician **was not** at a clinic with provider's enhanced report cards.
3. Patients whose report cards **were not** available at the point of care and whose primary physician was at clinic with provider's enhanced report cards.
4. Patients whose report cards **were not** available at the point of care and whose primary physician **was not** at a clinic with provider's enhanced report cards

Table 3 shows how the sites were randomized for the point-of-care patient report cards, as well as for the enhanced provider report cards.

Table 3. Randomization of enhanced provider report cards and on-site printable report cards

Clinic Name	Clinic Size	Enhanced Provider Report Cards	On-Site Printable Report Cards
Eastside Family Health Clinic (EFHC)	Large	Yes	Yes
Westside Family Health Clinic (WFHC)	Large	Yes	No
La Casa Quigg Newton (LCQN)	Large	No	Yes
Webb Primary Care (WEBB)	Large	No	No
Montbello Family Health Center (MONT)	Small	Yes	Yes
Westwood Family Health Center (WW)	Small	Yes	No
Parkhill Family Health Center (PH)	Small	No	Yes
Lowery Family Health Center (LOW)	Small	No	No

Qualitative Analysis. Key informants at each of the eight intervention and control clinics were asked to identify one health care provider for each site, to be considered "diabetes champion" (DC). The established DC at each clinic was then contacted and asked to consent to in-person interviews with the investigator, with all interview responses to be treated confidentially. All eight identified DCs agreed to participate.

Interviews were conducted with the eight DCs twice each, at the middle of the project period and after the intervention was completed. All interviews were conducted in a semi-structured format, according to an interview guide developed by the project team and approved by COMIRB (Appendix E) while also allowing for the in-depth exploration of additional topics and

areas of interest which might emerge and be identified during the interview. Interview topics included ways a provider might help patients manage diabetes, provider-level and clinic-level initiatives to improve diabetes care and intermediate diabetes health outcomes, the patient report card interventions (both mailed and on-site printed versions), and the provider performance report program.

As part of the usual process of diabetes care, providers at all eight community health clinics receive a provider report card, which is updated quarterly, published on an internal Web site, and presented to providers as an email containing a link. Previous reports are archived and remain available through the internal Web site. Reports include graphical comparisons of performance between clinics and between providers within a single clinic based on patients' diabetic control on three separate indicators (HgA1c, BP, and LDL) as a measure of clinic and provider achievement, and remain available once published.

Intervention and control groups containing four clinics each were established. Providers at clinics in the intervention group were sent a list in the same quarterly email with the link to the provider report card, containing the names of up to ten patients who were not under diabetic control. No suggestions were given in the email as to what might be done with the list. Providers at clinics in the control group continued to receive quarterly emails containing the link to the provider report card only.

One DC was unable to participate in the postintervention sessions, resulting in a total of fifteen interviews conducted. Fourteen interviews were audio recorded; one interview was recorded only through interviewer notes made during the session, at the request of the participating DC. All audio recordings and written notes were reviewed and transcribed by the conducting interviewer, with the participating DC identified in the transcripts by interviewer-assigned ID instead of by name.

Interview data were subjected to inductive analysis through both review of written transcripts and audio recordings. Themes and patterns identified among specific observations were then contextually evaluated and incorporated into a synthesis of results.

Cost Analysis. The evaluation of programmatic costs of the providers' enhanced report card includes assessment of the resources related to—

- Creating the enhanced provider report card with the list of patients specific to each provider.
- Distributing the provider report card to each of the providers.
- Providers' time related to contacting the diabetic patients listed on enhanced report card.
- IT development specific to creating the providers' enhanced form.

In the Final Report, the direct costs associated with implementing the provider report card will be compared to the benefits of the project as a whole.

Point-of-Care Reminders

In April, 2008, the diabetes registry was fully transitioned to the data warehouse where clinical information is now available to the provider in real time at the point of care. When a diabetic patient registers for a primary care visit, the data warehouse registry data can be accessed in order to print a list of indicated care for that patient. Currently, the point-of-care

interface allows for graphical display of patient performance on intermediate outcomes with comparison to expert recommended guidelines. In addition, the provider can display for a given patient a graphic depiction of that patient's adherence to diabetes, blood pressure, and cholesterol lowering medicines.

Clinical Outcomes. The medication recommendations were not included in the point-of-care reminders since there was concern that an inability to incorporate adverse drug interactions and, as a result, outcomes related to these recommendations will not be included in the final assessment. Instead, interviews of providers from the pilot site was performed and evaluated.

Process Outcomes. Point-of-care reminders are evaluated for a single pilot site in August 2008 through December 2008. We were able to automatically track how many point-of-care report cards were generated by providers. The information system was used to tabulate the number of report cards viewed.

Qualitative Analysis. The DC at the pilot site for the point-of-care report established the point-of-care intervention as a topic to be discussed during a regularly-scheduled health care provider team meeting, and also facilitated the attendance of the focus group interviewer at the meeting. Out of six health care providers at the pilot site, three were available to participate in the team meeting. The interviewer explained the purpose of the focus group session to meeting attendees, secured participants' consent, and subsequently involved them in discussion.

The topical structure of the guided group conversation was based on the interview guide developed for individual provider interviews, but with questions retailored to include details applicable to the point-of-care intervention rather than the provider performance feedback report. The session was audio recorded with the permission of all participants, and the recording was reviewed and transcribed by the focus group interviewer.

Cost Analysis. The evaluation of programmatic costs includes the resources related to—

- Providers' time in using point-of-service interface
- IT development specific to the point-of-service interface

Results

Mailed Report Cards

The demographics of the intervention and control groups for this prong of the intervention are provided in Table 4. The mean age of the group is just over 54 years old. Almost three-fifths (59.3 percent) of the patients are female and just over three-fifths (61.5 percent) are Hispanic. While the differences between intervention and control group in ages are significantly different (p-value = 0.05) and gender trends toward significantly different (p-value = 0.09) these differences are adjusted for in subsequent analyses.

Table 4. Demographics of the mailed patient report card groups

Demographics	All patients (n=5,457)	Intervention (n = 2,728)	Control (n = 2,729)	p-value
Mean Age (SD)	54.1	54.4 (11.9)	53.8 (12.0)	0.05
Gender				0.09
Gender: Female	59.3	58.1	60.4	
Gender: Male	40.7	41.9	39.6	
Gender: Total	100.0	100.0	100.0	
Race/Ethnicity				0.46
Race/Ethnicity: Asian	0.7	0.7	0.6	
Race/Ethnicity: African American	15.9	15.3	16.5	
Race/Ethnicity: Hispanic	61.5	61.6	61.4	
Race/Ethnicity: White	16.9	17.0	16.9	
Race/Ethnicity: Unknown ethnicity	5.0	5.4	4.6	
Race/Ethnicity: Total	100.0	100.0	100.0	

Process Outcomes

The patient report cards were mailed to the address listed for the most recent visit. Due to the high mobility of the safety net patient population, we were expecting a relatively high mail return rate. Process measures for this intervention include—

- # Mailed
- Mail return rate

These measures are included in Table 5. Fewer than 10 percent (9.8 percent) of the report cards were returned for having an incorrect address.

Table 5. Mailed report card mail return rate

Month	# of Report Cards Mailed	# of Report Cards Returned	Return Rate
December (2007)	909	80	0.088
January	910	80	0.088
February	909	80	0.088
March	897	87	0.097
April	896	84	0.094
May	893	83	0.093
June	895	88	0.098
July	892	93	0.104
Aug	893	89	0.100
Sep	893	98	0.110
Oct	887	103	0.116
Nov	893	93	0.104
TOTAL	10,767	1,058	0.098

Clinical Outcomes

Tables 6 and 7 provides the baseline and study period outcomes for both the intervention and the control groups for the mailed patient report cards. Intermediate clinical outcomes improved in both the intervention and the control groups; however, the quarterly patient mailings did not have a significant impact on diabetic outcomes. Patients in the control group were significantly more likely to continue having their HgA1c and their blood pressure tested than those in the intervention group (p < 0.01 for both). The study period analyses were adjusted to account for differences in age, race/ethnicity, gender, degree of illness, and baseline levels for each outcome variable, and included generalized estimated equations (GEE) to account for the within-subject correlation of repeated measures by individual patients. The baseline period analyses merely compare the intervention group to the control group with no time component. The testing variables reflect at least one test done in the year prior to the start of the study (baseline) or during the study period (intervention).

Table 6. Clinical and utilization outcomes, mailed patient report cards, mean HgA1c (SD)

Outcome	Baseline Intervention	Baseline Control	Baseline p-value	Study Period Intervention	Study Period Control	Study Period p-value*
Mean HgA1c (SD)	8.3 (2.2)	8.4 (2.3)	0.34	8.2 (2.3)	8.2 (2.3)	0.31

*Comparison outcomes between each intervention and the control group over time, adjusting for differences in demographics, degree of illness and baseline utilization

19

Table 7. Clinical and utilization outcomes, mailed patient report cards

Outcome	Baseline Inter-vention Yes (%)	Baseline Inter-vention Total N	Baseline Control Yes (%)	Baseline Control Total N	Baseline p-value	Study Period Inter-vention Yes (%)	Study Period Inter-vention Total N	Study Period Control Yes(%)	Study Period Control Total N	Study Period p-value*
HgA1c < 7	664 (30.3)	2,191	681 (30.1)	2,262	0.88	645 (35.5)	1,816	671 (35.3)	1,900	0.77
HgA1c Testing	2,191 (80.3)	2,728	2,262 (82.9)	2,729	0.21	1,816 (66.6)	2,728	1,900 (69.6)	2,729	<0.01
Lipid Profile Testing	1,740 (63.8)	2,728	1,779 (65.2)	2,729	0.28	1,540 (56.5)	2,728	1,575 (57.7)	2,729	0.10
LDL < 100 mg/dl	1,123 (64.5)	1,740	1,144 (64.3)	1,779	0.89	1,100 (71.4)	1,540	1,149 (72.9)	1,575	0.45
BP Testing	2,402 (88.0)	2,728	2,457 (90.0)	2,729	0.34	1,965 (72.0)	2,728	2,026 (74.2)	2,729	<0.01
Last BP < 130/80 mmHg	985 (41.0)	2,402	1,011 (41.2)	2,457	0.93	896 (45.6)	1,965	924 (45.6)	2,026	0.98

*Comparison clinical outcomes between the intervention and control group over time, adjusting for differences in demographics, degree of illness and baseline utilization.

Table 8 and 9 provide the sub-analysis of utilization outcomes when taking the number of clinical indicators at goal into account. This analysis helps to assess whether patient performance triggers a visit. The utilization outcomes are individually assessed for HbA1c testing, lipid profile testing, and blood pressure testing. The control group was compared to the intervention group for each of the following categories: (1) those with zero to one indicator at goal (Table 8) and (2) those with two or all three indicators at goal (Table 9). Similar to Table 7, the goals for the indicators are (1) HbA1c less than 7, (2) LDL less than 100 mg/dl, and (3) Last Blood Pressure less than 130/80 mmHg. For HbA1c testing rates, patients in the control group significantly outperform patients in the intervention group for both categories of having indicators at goal (p = 0.01 for those with 0 to 1 indicators at goal, p < 0.01 for those with 2 to 3 indicators at goal. However, for blood pressure testing, patients in the control group only outperformed patients in the intervention group when they had zero or one indicator at goal (p < 0.01). This may indicate that there is an unintended consequence of the report cards deterring people who are not doing well on their blood pressure indicators from coming in for a visit.

Table 8. Subanalysis of utilization outcomes by number of indicators at goal: 0 or 1 indicators at goal

Utilization Measure	Intervention Yes(%)	Intervention Total N	Control Yes(%)	Control Total N	p-value*
HgA1c Testing	884(62.7)	1,409	894(66.3)	1,349	0.01
Lipid Profile Testing	751(53.3)	1,409	733(54.3)	1,349	0.11
Blood Pressure Testing	960(68.1)	1,409	968(71.8)	1,349	<0.01

*Comparison outcomes between each intervention and the control group over time, adjusting for differences in demographics, degree of illness and baseline utilization

Table 9. Subanalysis of utilization outcomes by number of indicators at goal: 2 or 3 indicators in control

Utilization Measure	Intervention Yes(%)	Intervention Total N	Control Yes(%)	Control Total N	p-value*
HgA1c Testing	932(70.7)	1,319	1,006(72.9)	1,380	<0.01
Lipid Profile Testing	789(59.8)	1,319	842(61.0)	1,380	0.52
Blood Pressure Testing	1,005(76.2)	1,319	1,058(76.7)	1,380	0.55

*Comparison outcomes between each intervention and the control group over time, adjusting for differences in demographics, degree of illness and baseline utilization

Patient Satisfaction and Mailed Report Card Utility

Patients returned 349 surveys providing input on the mailed PRC, a total of 6.5 percent of surveys distributed. Table 8 provides details of mailings and responses over time. The low response rate is in line with our expectations for a survey that included neither incentives for participation nor reminders such as telephone calls or additional mailings. As such, qualitative analysis of survey responses was planned and conducted in order to identify common themes, patterns, and issues to be addressed among respondents' reactions to the patient report card intervention. Future studies which include followup reminders and participant incentives might secure results which could be generalized in a broader fashion.

Table 10. Survey mailing and response

	Surveys Distributed	Responses Received	Response Rate (%)
March	897	60	6.69
April	896	72	8.04
May	893	66	7.39
2nd Quarter	**2,686**	**198**	**7.37**
September	893	38	4.26
October	887	52	5.86
November	893	61	6.83
4th Quarter	**2,673**	**151**	**5.65**
Total	**5,359**	**349**	**6.51**

Most respondents expressed overall satisfaction with the design, usability, and content of the mailed report cards and indicated a wish to continue receiving them. Regardless of the fact that only one-third of respondents (33.2 percent) reported taking the report card to their next clinic visit, respondents also felt that their health care providers had helped them both understand and use the diabetes report card. Over three-quarters of respondents indicated that the report card had helped them to set diabetes self-management goals (77.4 percent), over half (52.7 percent) reported that their diabetes had improved since beginning to receive report cards, and two-thirds (67.6 percent) indicated that they can control their diabetes, as shown in Table 11.

Table 11. Patient satisfaction with mailed report cards

Content, assistance, and control	Strong-ly Agree N	Strong-ly Agree %	Agree N	Agree %	Neu-tral N	Neu-tral %	Dis-agree N	Dis-agree %	Strong-ly Dis-agree N	Strong-ly Dis-agree %	No Resp-onse N	No Resp-onse %
The report card was clear and easy to understand.	219	62.75	94	26.93	17	4.87	7	2.01	1	0.29	11	3.15
The information on the report card was correct.	193	55.30	99	28.37	23	6.59	12	3.44	5	1.43	17	4.87
The information on the report card was helpful.	202	57.88	104	29.80	19	5.44	5	1.43	4	1.15	15	4.30
I would like to keep receiving report cards.	220	63.04	73	20.92	14	4.01	14	4.01	14	4.01	14	4.01
My health care provider helped me understand the report card.	121	34.67	71	20.34	39	11.17	24	6.88	12	3.44	82	23.50
My health care provider helped me use the report card.	100	28.65	77	22.06	43	12.32	23	6.59	14	4.01	92	26.36
My health care provider should take more time to review my report card with me.	65	18.62	67	19.20	62	17.77	37	10.60	23	6.59	95	27.22
The report card helped me set goals to improve my diabetes.	157	44.99	113	32.38	33	9.46	9	2.58	4	1.15	33	9.46
My diabetes has gotten better since receiving report cards.	105	30.09	79	22.64	85	24.36	24	6.88	8	2.29	48	13.75
I can control my diabetes.	123	35.24	113	32.38	48	13.75	14	4.01	11	3.15	40	11.46

Respondents who did not take the report card to a primary care visit were invited to share their reasons, and all respondents were offered the opportunity to provide additional comments and suggestions about the report card in an unstructured fashion. Of the 349 respondents, 199 offered remarks elaborating on reasons for not bringing the report card to their providers, and 195 elected to provide one or more additional comments.

Examination of the reasons for not taking the report card to a visit resulted in the emergence of six core themes:

- I have not seen my provider yet / since receiving the report card (48 responses).
- I forgot to bring it (41 responses).
- My provider already knows / has this information (26 responses).
- I did not know I was supposed to bring it (22 responses).
- This is the first card I have received (15 responses).
- I did not have the report card (11 responses).

Additional general reaction to the report cards was found to be positive overall, with 45 respondents offering some indication of approval and 26 expressing specific thanks. Some opportunities for improvement were identified as well, with a number of respondents pointing out incorrect diagnoses or information (13 responses) or expressing other disapproval (9 responses). Respondents also actively engaged with the intervention by offering suggestions for report card improvement or additional approaches that might be taken (21 responses).

Respondents valued receiving information about diabetes and diabetes-related topics, as indicated by requests for additional information (23 responses), more explanation of what information was provided on the report cards (13 responses), or remarks on their own clinical information (18 responses). Of particular note is that several respondents took the opportunity to freely indicate perceived improvement in their own self-efficacy (22 responses).

Cost Analysis

Table 12 provides the estimated health care system costs related to mailing 10,767 patient report cards to 2,692 patients over a 12-month period. These mailed report cards cost an estimated $19,749.

The evaluation of programmatic costs include the resources related to—

- Creating the patient mailing lists and information.
- Quality control of the diabetes registry data.
- Printing and preparing mailings.
- Postage.
- Supporting the IT development specific to creating the patient report card.

The data applications analyst monitored the registry and performed quality control for an estimated 8 hours a month for the year for a total of 96 hours. It took approximately 13.5 person hours to prepare and stuff the envelopes each month for a total of 162 hours for the 12 months of mailings. Three physicians and nonmedical staff had five 2-hour meetings for a total of 30 hours for the physicians to develop the mailed report cards. The nonmedical staff had additional

development meetings and individual development time for a total of 60 hours of development. The hourly rates are based on salary and benefits related to the level of staff that performed each task.

Table 12. Cost for program implementation for mailed report cards

Line Item	Number	Hours	Rate	Number x Rate
Postage	10,767		0.394	4,242
Returned report cards	1,058		0.5	529
Tri-folding machine	1		500	500
Envelopes (boxes)	22		6.97	153
Paper (cartons)	9		20.97	189
Business reply account	1		175	175
Business reply envelopes (boxes)	2		200	400
Postage–business reply	349		1.14	398
Translation to Spanish (by word)	1,653		0.11	182
Monitor/QC for registry		96	28.75	2,760
Prep/Stuffing envelopes		162	30.75	4,982
Development/physicians		30	123	3,690
Development/other		60	25.83	1,550
IT development		0	0	0
Subtotal Estimate				19,749

The costs associated with the time taken by the providers to review the report cards with patients that brought the report cards to their clinic visits were not included. A business reply account is required ($175 annually) to receive replies to the patient surveys. In the event that surveys are not a component of an intervention modeled after this, the business reply account, envelopes and postage will not be necessary. For this intervention, surveys were sent to one-half of the participants two times over the course of the one-year study period, for 5,359 total surveys sent.

As the mailed report cards did not have a significant positive impact on clinical outcomes, a cost effectiveness analysis of this intervention is not pertinent. Although, according to the qualitative analysis and survey responses, patients valued the information on the report card, where some patients perceived their diabetic outcomes improved because of the report cards. Therefore, even though there was not a significant clinical improvement related to the patient report cards, communicating clinical results to patients may improve patient satisfaction.

Provider Enhanced Report Cards

Randomization for the on-site report cards and the enhanced provider report cards took place at the clinic level and resulted in similar gender and age distribution for the four groups (Table 13). The groups differed significantly in race/ethnicity, as expected given the different neighborhoods served by each clinic. These differences were adjusted for in analysis. Patients lost to follow up in the intervention group were not significantly different in demographic makeup to those in control group and were analyzed with an intention-to-treat threshold.

Table 13. Patient demographics for on-site patient report cards and enhanced provider report cards

	All patients N=5,457	On-Site Ability to Print Intervention N=2,357	On-Site Ability to Print Control N=3,100	On-Site Ability to Print p-value	Enhanced Provider Report Cards Intervention N=2,893	Enhanced Provider Report Cards Control N=2,564	Enhanced Provider Report Cards p-value
Mean Age (SD)	54.1	54.3 (11.9)	54.0 (12.1)	0.36	54.2 (11.9)	54.0 (12.1)	0.53
Gender				0.14			0.07
Gender: Female	59.3	58.4	60.4		60.4	58.0	—
Gender: Male	40.7	41.6	39.6		39.6	42.0	
Gender: Total	100.0	100.0	100.0		100.0	100.0	
Race/Ethnicity				<0.01			<0.01
Race/Ethnicity: Asian	0.7	0.4	0.8		0.7	0.6	
Race/Ethnicity: African American	15.9	24.7	9.2		15.6	16.3	
Race/Ethnicity: Hispanic	61.5	58.6	63.7		64.0	58.7	
Race/Ethnicity: White	16.9	10.9	21.6		14.5	19.7	
Race/Ethnicity: Unknown	5.0	5.4	4.7		5.2	4.7	
Race/Ethnicity: Total	100.0	100.0	100.0		100.0	100.0	

Clinical Outcomes

The results for the on-site printable report cards and enhanced provider report cards were run in a 2x2 factorial design in order to discern which contributed to significant outcomes since both were implemented in the hopes of affecting clinical outcomes. Patients on all intervention arms were also compared to those on no intervention arms to determine a combination effect. The analyses are presented here separately first, then in combination. The main analyses use an intention-to-treat threshold. An additional analysis using matched controls to better understand the results of the main analyses is included following the main analyses.

On-site Printable Report Cards. Table 14 provides the outcomes of the analyses for the on-site printable report cards. Patients were significantly more likely to improve their glycemic and blood pressure levels at clinics that did not have the ability to print on-site patient report cards (p < 0.01 for both). Patients at sites that did not have on-site print capacity had an absolute increase in glycemic control of 6.3 percent from baseline, compared to only 3.8 percent for those with on-site print capacity. Patients at sites that did not have on-site print capacity had an absolute increase in blood pressure control of 6.9 percent from baseline, compared to only 1.3 percent for those with on-site print capacity.

Table 14. Clinical outcomes for on-site printable report cards—intention to treat

Outcome	On-Site Cards Available Yes (%)	On-Site Cards Available Total N	On-Site Cards Not Available Yes (%)	On-Site Cards Not Available Total N	p-value*
HbA1c < 7%					<0.01
HbA1c < 7%: Baseline	590(30.7)	1,920	755(29.8)	2,533	
HbA1c < 7%: Study period	553(34.5)	1,602	763(36.1)	2,114	
HbA1c < 7%: Absolute % change	3.8		6.3		
LDL < 100 mg/dl					0.72
LDL < 100 mg/dl: Baseline	906(61.6)	1,472	1361(66.5)	2,047	
LDL < 100 mg/dl: Study period	922(69.1)	1,335	1327(74.6)	1,780	
LDL < 100 mg/dl: Absolute % change	7.5		8.1		
BP< 130/80 mm HG					<0.01
BP< 130/80 mm HG : Baseline	798(38.3)	2,083	1198(43.2)	2,776	
BP< 130/80 mm HG : Study period	680(39.6)	1,716	1140(50.1)	2,275	
BP< 130/80 mm HG : Absolute % change	1.3		6.9		

*Comparison outcomes between each intervention and the control group over time, adjusting for differences in demographics, degree of illness and baseline utilization

Figure 3 provides a graphical display of the absolute percent change in control for each of the outcomes for clinics with and without on-site print capacity. While clinics without on-site print capacity performed slightly better in raw lipid improvement from baseline of 8.1 versus 7.5 for clinics with on-site print capacity, this result was not significant (p = 0.72).

Figure 3. Absolute percent change in control for all clinical outcomes by on-site print capacity
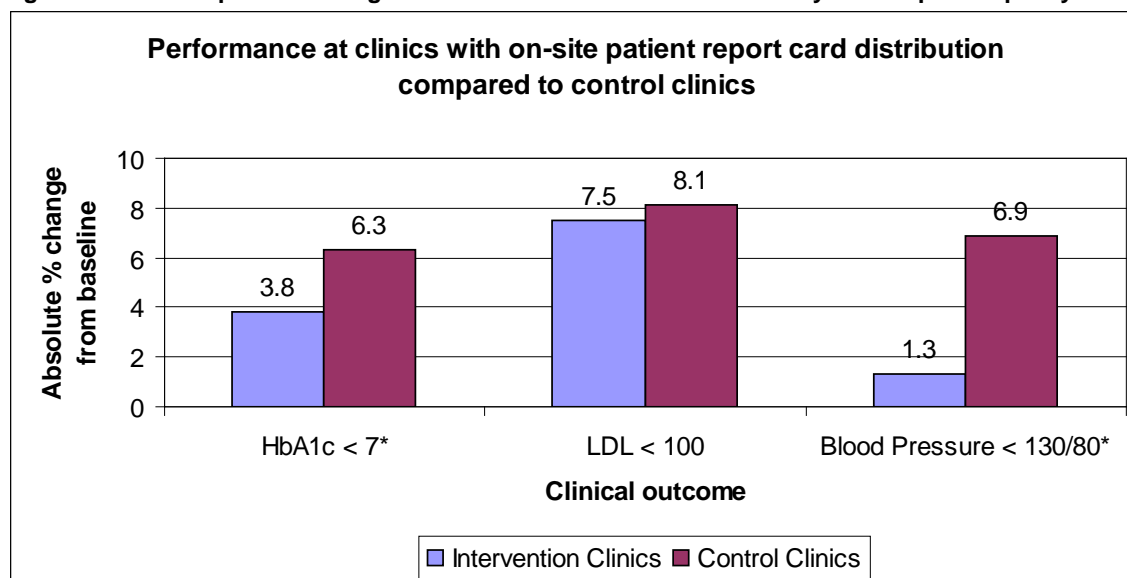

*p-value < 0.01

Enhanced Provider Report Cards. Patients at clinics with the enhanced provider report cards had significantly greater absolute percent increase in glycemic control compared with patients at clinics with the standard provider report cards (6.4 percent versus 3.8 percent respectively, p < 0.01, Table 15). Absolute percent improvements in lipid and blood pressure control at the enhanced provider report card sites (7.9 percent and 5.6 percent respectively) compared to the standard provider report card sites (7.7 percent and 3.3 percent respectively) were not statistically significant (Figure 4).

Table 15. Clinical outcomes for enhanced provider report cards—intention to treat

Outcome	At Enhanced Provider report card clinic, Yes (%)	At Enhanced Provider report card clinic, Total N	Not At Enhanced Provider report card clinic, Yes (%)	Not At Enhanced Provider report card clinic, Total N	p-value*
HbA1c < 7%,					−<0.01
HbA1c < 7%: Baseline	653(27.5)	2,374	692(33.3)	2,079	
HbA1c < 7%: Study period	669(33.9)	1,972	647(37.1)	1,744	
HbA1c < 7%: Absolute % change	6.4		3.8		
LDL < 100 mg/dl,					0.90
LDL < 100 mg/dl: Baseline	1,227(65.3)	1,878	1,040(63.4)	1,641	
LDL < 100 mg/dl: Study period	1,220(73.2)	1,667	1,029(71.1)	1,448	
LDL < 100 mg/dl: Absolute % change	7.9		7.7		
Last Blood Pressure < 130/80 mm HG,					0.09
Last Blood Pressure < 130/80 mm HG: Baseline	1,074(41.7)	2,577	922(40.4)	2,282	
Last Blood Pressure < 130/80 mm HG: Study period	1,000(47.3)	2,115	820(43.7)	1,876	
Last Blood Pressure < 130/80 mm HG: Absolute % change	5.6		3.3		

*Comparison outcomes between each intervention and the control group over time, adjusting for differences in demographics, degree of illness and baseline utilization

Figure 4. Absolute percent change in control for all clinical outcomes: enhanced provider report card clinics versus standard provider report card clinics
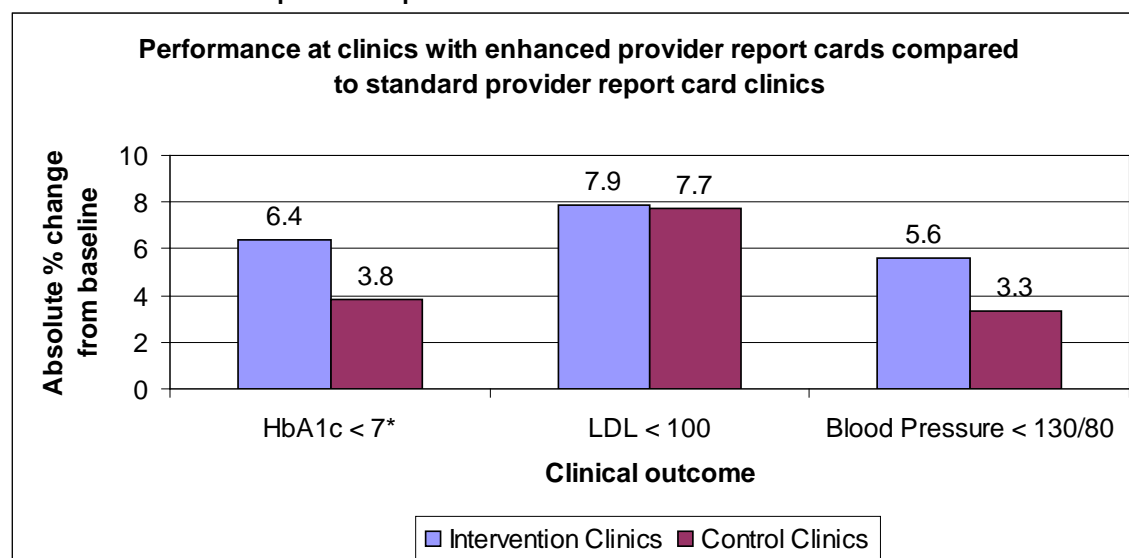
*Comparison outcomes between each intervention and the control group over time, adjusting for differences in demographics, degree of illness and baseline utilization

On-site printable report cards by Enhanced provider report cards (2x2) analyses. Patients at two clinics both received the on-site report cards and were assigned to providers receiving the enhanced provider report cards. These patients performed the same on glycemic and lipid measures but worse on blood pressure control than patients at the two clinics receiving neither of these interventions (Table 16). These intervention patients had an 0.5 percent absolute increase in blood pressure control (< 130/80 mmHg) compared to a 3.8 percent absolute increase among control patients (p=.04).

Table 16. Clinical outcomes for on-site printable patient report cards and enhanced provider report cards—intention to treat

Outcome	Neither Report Card Yes (%)	Neither Report Card Total N	Onsite Patient Report Cards Only, Yes (%)	Onsite Patient Report Cards Only, Total N	p-value*	Enhanced Provider Report Cards Only Yes (%)	Enhanced Provider Report Cards Only Total N	p-value*	Both Report Cards Yes (%)	Both Report Cards Total N	p-value*
HbA1c < 7%					0.68			0.14			0.78
Baseline	364(33.8)	1,074	328(32.6)	1,005		391(26.8)	1,459		262(28.6)	915	
Study period	340(38.4)	885	307(35.7)	859		423(34.4)	1,229		246(33.1)	743	
Absolute % change	4.6		3.1			7.6			4.5		
LDL < 100 mg/dl					0.84			0.49			0.44
Baseline	583(65.1)	896	457(61.3)	745		778(67.6)	1,151		449(61.8)	727	
Study period	547(72.8)	751	482(69.2)	697		780(75.8)	1,029		440(69.0)	638	
Absolute % change	7.7		7.9			8.2			7.2		
BP < 130/80 mmHg					0.24			<0.01			0.04
Baseline	527(43.5)	1,210	395(36.9)	1,072		671(42.9)	1,566		403(39.9)	1,011	
Study period	461(47.3)	974	359(39.8)	902		679(52.2)	1,301		321(39.4)	814	
Absolute % change	3.8		2.9			9.3			-0.5		

*Comparison outcomes between each intervention and the control group over time, adjusting for differences in demographics, degree of illness and baseline utilization

Patients on All Interventions versus None. There was no difference in process or intermediate outcomes between patients that received all three interventions (mailed patient report cards, on-site printable report cards, and providers with enhanced provider report cards) and those that received none of the interventions (Table 17).

Table 17. Clinical outcomes for mailed patient report cards, point-of-care patient report cards and enhanced provider report cards—patients in all interventions versus patients in none

Outcome	On All interventions Yes (%)	On All interventions Total N	On No interventions Yes (%)	On No interventions Total N	p-value*
HbA1c < 7%					0.36
HbA1c < 7%: Baseline	131(29.2)	448	188(34.5)	545	
HbA1c < 7%: Study period	125(34.9)	358	171(38.3)	446	
HbA1c < 7%: Absolute % change	5.7		3.8		
LDL < 100 mg/dl					0.85
LDL < 100 mg/dl:Baseline	225(61.3)	367	284(64.3)	442	
LDL < 100 mg/dl:Study period	218(71.0)	307	269(72.5)	371	
LDL < 100 mg/dl:Absolute % change	9.7		8.2		
BP < 130/80 mmHg					0.26
BP < 130/80 mmHg :Baseline	200(39.7)	504	250(41.2)	607	
BP < 130/80 mmHg :Study period	161(39.9)	404	225(46.6)	483	
BP < 130/80 mmHg :Absolute % change	0.2		5.4		

*Comparison outcomes between each intervention and the control group over time, adjusting for differences in demographics, degree of illness and baseline utilization


Enhanced Provider Report Cards with Matched Controls—Subanalysis. To determine if the intention to-treat analysis of the enhanced report cards hid significant findings as a result of the error toward the mean nature of incomplete penetration, an additional analysis compared those patients listed on provider performance report cards to matched controls (Table 18 and Figure 5). This analysis was accomplished by applying the same quarterly criteria used to create the intervention group to a matched group in the clinics without enhanced provider report cards. Patients on the provider report cards improved an additional absolute 5.4 percent on the glycemic target, 6.2 percent on the lipid target, and 2.7 percent on the blood pressure target; however, as with the original intention-to-treat analysis, glycemic performance was the only measure that achieved statistical significance ($p < 0.01$).

Table 18. Clinical outcomes for enhanced provider report cards—with matched controls

Outcome	On Enhanced Provider report card Yes (%)	On Enhanced Provider report card Total N	On Simulated report card Yes (%)	On Simulated report card Total N	p-value*
HbA1c < 7					−<0.01
HbA1c < 7: Baseline	185(20.0)	922	240(23.3)	1,030	
HbA1c < 7: Study period	216(29.6)	730	241(27.5)	875	
HbA1c < 7: Absolute % change	9.6		4.2		
LDL < 100 mg/dl,					0.10
LDL < 100 mg/dl: Baseline	353(47.4)	745	443(52.4)	845	
LDL < 100 mg/dl: Study period	467(63.8)	732	393(62.6)	638	
LDL < 100 mg/dl: Absolute % change	16.4		10.2		
BP < 130/80 mmHg,					0.22
BP < 130/80 mmHg: Baseline	332(33.5)	990	397(35.4)	1,121	
BP < 130/80 mmHg: Study period	380(40.9)	930	311(40.1)	775	
BP < 130/80 mmHg: Absolute % change	7.4		4.7		

*Comparison outcomes between each intervention and the control group over time, adjusting for differences in demographics, degree of illness and baseline utilization

Figure 5. Absolute percent change in control for all clinical outcomes: enhanced provider report card clinics versus standard provider report card clinics using matched controls

Performance for patients targeted on provider performance report cards compared to matched controls
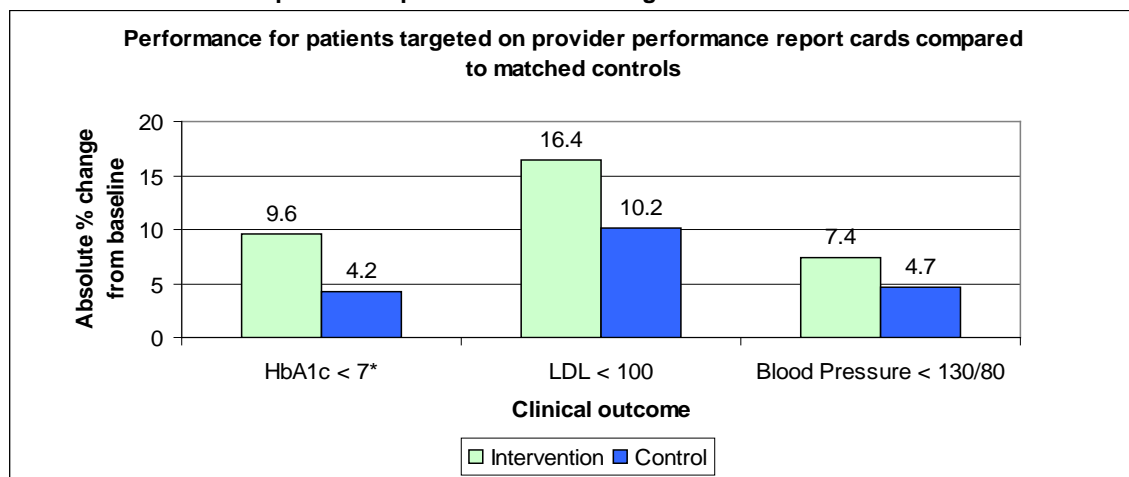
* p-value < 0.01

Qualitative Analyses and Outcomes

Provider Interviews. All providers interviewed indicated familiarity with the provider report cards, but were generally uncertain as to how often they were updated or made available. Most providers were uncertain of how to access the provider report cards aside from the emailed link; in the two interview sessions where access was immediately attempted, one was unable to locate them at all, and the other was successful only after time spent searching.

Time was repeatedly noted as a factor, with emphasis placed on the short length of patient visits, the increasing numbers of patients to be seen, and the ever-increasing number of things to accomplish both during patient visits and in the course of a clinical day. As a result, a tool which is perceived as requiring excess time is extremely unlikely to be utilized.

Sustained provider report card usage is evidently rare. Providers indicated a general pattern of looking at the report card when it was published, then setting it aside and not doing anything else with it. Some utility was found in that the report card was indicated to be helpful in identifying trends and raising awareness; however, it was also suggested that while information is useful, information with guidance or assistance would be better. Interviewees reported a common reaction among providers of "I know this, but what can I do to change it?" as well as a perception that providers are already aware of the issues but lack resources to address them. Specific examples of desired resources include additional personnel for education and case management as well as the equipment and materials needed to conduct A1c testing at the point of care.

The provider report card was also seen to promote a sense of competition among providers and among clinics. Reactions to such competition were mixed, with more than one provider noting that while it might be useful for motivation among physicians, who are perceived as being generally 'more competitive' or used to competition, it might be less well received among other members of a clinic team. Provider frustration with a perceived inability to affect change was mentioned as a concern and possible negative consequence; it was also noted that a focus on provider performance related to diabetes excluded mention of successes or issues in other areas of care.

30

Perception among those who received the enhanced report card was that the list of patient names contained too few items and was not sent frequently enough. Concurrent initiatives were identified at two of the intervention clinics that involved generating separate, more frequent, and more inclusive lists of patients and distributing them to providers for action – efforts that may have affected the results of the enhanced report card intervention. Other concurrent initiatives reported during interviews that may have influenced study outcomes include telephone nurse case management initiatives, programs to promote establishing diabetes self-management goals, a focused clinic-level program to improve cholesterol levels, and a system-wide medication reconciliation program.

Design suggestions included making the provider report card easier to read without scrolling up and down on the computer screen, including a within-clinic comparison of provider performance to that of the clinic as a whole, and altering the number of data points or the duration of the reporting period to make it easier to observe changes in diabetic indicators as well as trends over time. Distribution suggestions included making the provider report card easier to find on the system, distributing it more frequently, and giving a copy directly to providers rather than requiring them to locate it on the system.

Cost Analysis

The evaluation of programmatic costs of the providers' enhanced report card includes assessment of the resources related to:

- Creating the enhanced provider report card with the list of patients specific to each provider.
- Distributing the provider report card to each of the providers.
- Providers' time related to contacting the diabetic patients listed on enhanced report card.
- IT development specific to creating the providers' enhanced form.

Table 19 provides the estimated costs associated with the provider enhanced report cards. The health care provider costs associated with the provider enhanced report cards for the 12-month intervention period was $45,928.

Three providers participated in three 2-hour meetings, plus individual provider time for an estimated 40 hours of effort in developing the enhanced provider report cards. Nonmedical staff was also included in the meetings and had individual time for an estimated 40 hours of effort in developing the enhanced provider report cards. Providers spent an estimated 320 hours organizing data and contacting patients at the four clinics with enhanced report cards. The project manager took approximately 12 hours to prepare and distribute each of the quarterly enhanced report cards and the data applications analyst took approximately 16 hours for a total of 48 and 64 hours, respectively. Forty hours of the Data Warehouse Architect's time is attributed to this arm of the intervention. Costs associated with transferring and converting the diabetes registry into the data warehouse was not separated by intervention arm. It is estimated that 40 hours of IT development time was related to the transferring and converting the enhanced form to the data warehouse. The hourly rates include salary and benefits.

Table 19. Cost for program implementation for enhanced provider report cards

Line Item	Number or Hours	Rate	Number x Rate
Development/providers	40	104.5	4,180
Development/other	40	25.83	1,033
Provider time contacting patients*	320	104.5	33,440
Salary for prep and distribution	48	37.06	1,779
Salary for prep and distribution cont'd	64	23.37	1,496
IT development specific to enhanced form	40	100	4,000
Total Estimate			45,928

Glycemic control (the percentage of patients with HgA1c less than 7) was the only intermediate outcome that had a significantly higher percent change from baseline for the intervention group than the control group ($p < 0.01$, see Table 15). An additional 6.4 percent of the patients in the intervention group achieved control over baseline versus an additional 3.8 percent of the nonintervention group over baseline (Table 20). Therefore, the rate of glycemic control for the intervention group was 2.6 percent higher (6.4 percent - 3.8 percent = 2.6 percent) than the control group. Multiplying this 2.6 percent increase to the total number of patients for whom we had labs after the study period ($N = 1,972$) yields the total number of additional patients controlled for HgA1c in the intervention group: 51 patients (Table 20).

Table 20. Glycemic control* over time by enhanced provider report card group

	Baseline N (%)	Study Period N (%)	Percent Difference Over time
Intervention (**N = 1,972**)	542 (27.5)	669 (33.9)	6.4
Control (N = 1,744)	581 (33.3)	647 (37.1)	3.8
Percent Difference b/w Groups			**2.6**

Number of additional patients controlled for A1c: **1,972** total patients x **2.6 percent** increase in control = 51
*HgA1c < 7

The total program costs related to the enhanced provider report card to the health care system was $45,928 (Table 17). **As there were an additional 51 patients with glycemic control for those patients listed on the enhanced provider report card, it cost the health care system $901 per additional glycemic controlled patient for this intervention.**
While most of the costs associated with this intervention are variable according to the number of patients that need to be contacted, some economies of scale can be realized if this intervention is applied to larger groups of patients as development and to a lesser degree preparation and distribution costs are largely fixed.
The patients lost to followup did not disproportionately have higher baseline glycemic control rates than those for whom we had labs at the end of the study period. Also, patients in the two groups had very similar rates of inclusion in the patient report card intervention, 51.2 percent for the intervention group versus 51.0 percent for the control group.

Point-of-Care Reminders

Clinical Outcomes

Point-of-care reminders were not expected to drive clinical indicators as the period of performance being assessed is too short. The quantitative assessment of this intervention is limited to the providers' utilization of the report in the process outcomes section.

Process Outcomes

Point-of-care reminders were evaluated for a single pilot site in August 2008 through December 2008. We were able to automatically track how many point-of-care report cards were generated by providers. The information system was used to tabulate the number of report cards viewed.

Table 21 provides the number of providers who accessed the report and how many times the report was accessed at the pilot site by month for the analysis period. No providers at the pilot site accessed the report prior to additional education in September. September was the most highly accessed month, with half of the providers accessing the report and a total of six views of the point-of-care reports. Subsequently, utilization diminished, until it was again not accessed by any providers in December, the final month of analysis. Utilization of point-of-care reminders was far less than anticipated. Providers at the pilot site accessed the reminders only nine total times. The qualitative assessment provides some insight as to why they were not utilized.

Table 21. Utilization of the point-of-care reminders at pilot site

Month	Number of Providers who accessed*	Number of times accessed
August	0	0
September	3	6
October	2	2
November	1	1
December	0	0

*there are six total providers at the pilot site

Qualitative Outcomes

The DC at the pilot site for the point-of-care report established the point-of-care intervention as a topic to be discussed during a regularly-scheduled health care provider team meeting, and also facilitated the attendance of the focus group interviewer at the meeting. Out of six health care providers at the pilot site, three were available to participate in the team meeting. The interviewer explained the purpose of the focus group session to meeting attendees, secured participants' consent, and subsequently involved them in discussion.

The topical structure of the guided group conversation was based on the interview guide developed for individual provider interviews, but with questions retailored to include details applicable to the point-of-care intervention rather than the provider performance feedback report.

The session was audio recorded with the permission of all participants, and the recording was reviewed and transcribed by the focus group interviewer.

The point-of-care reminder tool was perceived as an efficient means for collecting diabetes-related patient information together in one place, thus potentially providing easier access to the collected data for the provider. However, access to the report itself was found to be much more problematic. One focus group participant had attended a training session on how to use it, but was unable to locate it again upon later attempts to do so, while another participant, having missed the initial training session, was not aware of the existence of the reminder at all.

Additional misgivings were expressed about the usefulness of the reminder at the point of care itself. For example, while the reminder is computer-based, not all providers use a computer during the patient encounter. There was also concern that the reminder as designed might be too advanced for patient understanding; in addition, the lack of translation into languages besides English was noted. It was suggested that the reminder might have greater utility as a chart review mechanism tailored to providers alone than as a point-of-care tool intended for use by the provider together with the patient.

A weakness in the reminder design was also noted by the focus group, who observed that the color-coding used to indicate a patient's prescribed medications at the top of the page did not match the colored bar at the bottom of the page used to indicate medication compliance by refill information. In addition, it was noted that the medication data were limited to those for prescriptions filled at Denver Health, where a number of patients might fill their prescriptions outside the system in order to achieve a more cost-effective solution.

Cost Analysis

Table 22 provides the estimated costs associated with the point-of-care reminder reports. The estimated cost for this intervention was $159,289, with the great majority of the costs associated with IT development. While this development, which constituted putting the registry into the data warehouse will provide benefits outside of the scope of this intervention and project, this intervention was the initial reason for putting it into the warehouse. Approximately $50,000 of the IT development went into the design phase of the project and approximately $100,000 was used to construct and convert the template from the hypertension registry into the point-of-care reminders.

This arm of the intervention was not intended to drive intermediate outcomes so a cost effectiveness assessment was not performed.

Table 22. Cost for program implementation for enhanced provider report cards

Line Item	Number or Hours	Rate	Number x Rate
Development/providers	40	104.5	4,180
Development/other	40	25.83	1,033
Provider time accessing reminders*	39	104.5	4,076
IT development specific to enhanced form	1500	100	150,000
Total Estimate			159,289

*Includes all providers, not just those at the pilot site

Lessons Learned/Unintended Consequences

Several themes and lessons have emerged from the program implementation and analyses:

- Provider buy-in is mandatory for success.
- Concomitant quality improvement efforts make it challenging to isolate the effects of an intervention implemented across a number of outlying clinics.
- Qualitative analysis is key in order to identify noninterventional quality improvement efforts and other factors that have the potential to influence the implementation and outcomes of an intervention in order to incorporate their effects into the final analysis
- One challenge of implementing a control group of providers or clinics is the perception at the nonintervention sites that they are being prevented from using useful intervention tools and that this detracts from the quality of their patient care (like the patient report card).
- However, studying the impact of this type of intervention is invaluable as it provides evidence as to how to best allocate resources. For instance, patient report card mailings are fairly resource intensive yet, unexpectedly, did not impact process outcomes. On the other hand, on-site printable patient report cards generate a useful and effective tool for providers and patients.
- When automating care delivery using a large chronic disease registry, it is paramount to best ensure the quality of the data of the registry. Our largest concern was dissemination of diabetes report cards to patients incorrectly labeled with diabetes (through an incorrect ICD-9 code). "Cleaning-up" of the registry prior to randomization through provider-level manual review of patient lists was effective.
- Implementing an intervention that involves point-of-care computer-generated tools requires frequent contact with the sites to rapidly detect and problem-solve technological glitches (intermittent printing problems in the initial stages in our case).
- Qualitative analysis uncovers important provider and patient attitudes towards the interventions. For instance, providers respond to performance feedback and improve the quality of care they deliver. However, providers note that (i) the provider-level performance comparison fosters competition and (ii) more support, such as case management, is needed to assist providers with patient-level feedback (the enhanced provider report card). We will continue to use our registry to automate patient-level feedback, but will encourage a team-based approach to patient outreach.
- Mailed patient report cards may have the unintended consequence of deterring people who are not doing well on their blood pressure indicators from coming in for a visit.
- Although the on-site printable provider report cards did not improve clinical outcomes, both patients and providers expressed satisfaction with its potential to motivate behavioral change. We will continue to distribute an enhanced version of the patient report card at the point of care.
- We can automate a diabetes registry and improve care by delivering targeted patient-specific data.
- It is difficult to make overall assessments of diabetes care absent a single variable which indicates a combination of levels of glycemic, hypertensive, and cholesterol control.

Recommendations for Future Implementations

The Lessons Learned and unintended consequences provide for recommendations for future implementations:

- Iterative qualitative assessment in the form of surveys and interviews allow for streamlining, constant improvement, more buy-in, and an increased likelihood of sustained use.
- Use a mixed methods quantitative/qualitative approach to analysis for complete understanding of how well the program is working/not working.
- When migrating a registry into the data warehouse allow for ample time. We allotted 6 months and had previous experience in such transitions. This seemed to be about the correct amount of time.
- For recurring mass mailings, consider getting a tri-folding machine of at least moderate quality ($500). The time saved in folding will more than make up for the cost.
- If the goal is to improve the process outcomes of increased preventive care visits, we recommend the redistribution of resources away from patient mailings.
- Provider time is extremely limited. To the greatest extent possible, make any changes without adding to their time
- When creating reports with color, consider using universally applied cues, such as a traffic light pattern of red indicating a problem, yellow a warning, and green being good.
- When providing tools intended to improve patient care, try to provide support in the form of suggestions and guidance without orders and mandates
- We believe an alternative model worth exploring is a centralized "Health Status Center" which a patient could access at any time to facilitate lab and blood pressure tests, health care maintenance, and other recommended care, such as referrals to ophthalmology or podiatry.
- Additionally, the Health Status Center would proactively reach out to patients and bring attention to health care needs by communicating with patients through their preferred modalities of communication, such as direct mail, phone calls, text messaging, and/or email.
- Given the positive qualitative feedback and the automation that facilitated on-site printable patient report cards with minimal resource utilization, we recommend it despite inconsistency with quantitative outcomes.
- The development of a new, single outcome which is comprised of the combination of the intermediate outcomes of glycemic, blood pressure, and cholesterol control, would be extremely helpful in evaluating and analyzing the care of patients with diabetes.
- A longer study period would allow for greater penetration and perhaps a more accurate depiction of the benefits for any arm of this study.
- Increased patient satisfaction should be monitored as it is a great benefit regardless of whether it results in improved clinical outcomes.

References

1. California Healthcare Foundation. Using Computerized Registries in Chronic Disease Care. February 2004. Available at: http://www.chcf.org/publications/2004/02/using-computerized-registries-in-chronic-disease-care.

2. Bodenheimer T, Wagner EH, Grumbach K. Improving primary care for patients with chronic illness: The chronic care model, Part 2. JAMA 2002;288:1909-14.

3. Bodenheimer T, Wagner EH, Grumbach K. Improving primary care for patients with chronic illness. JAMA 2002;288:1775-9.

4. Gabbay RA, Khan L, Peterson KL. Critical features for a successful implementation of a diabetes registry. Diabetes Technol Ther 2005;7(6):958-67.

5. American Diabetes Association. Economic costs of diabetes in the US. Diabetes Care 2008;31:596-615.

6. Wild S, Roglic G, Green A, et al. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. Diabetes Care 2004 May;27(5):1047-53.

7. Hogan P, Dall T, Nikolov P. Economic costs of diabetes in the US in 2002. Diabetes Care 2003;26:917-32.

8. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). UK Prospective Diabetes Study (UKPDS) Group.[see comment][erratum appears in Lancet 1999 Aug 14;354(9178):602]. Lancet 1998;352(9131):837-53.

9. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. The Diabetes Control and Complications Trial Research Group.[see comment]. NEJM 1993;329(14):977-86.

10. American Diabetes Association. Available at: http://www.diabetes.org/. Accessed August 7, 2011.

11. National Heart Lung and Blood Institute. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7).

Available at: http://www.nhlbi.nih.gov/guidelines/ hypertension/. Accessed August 7, 2011.

12. National Heart Lung and Blood Institute. Third Report of the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) http://www.nhlbi.nih.gov/guidelines/cholesterol/

13. Cleveringa FG, Gorter KJ, van den Donk M, et al. Combined task delegation, computerized decision support, and feedback improve cardiovascular risk for type 2 diabetic patients: a cluster randomized trial in primary care. Diabetes Care 2008 Dec;31(12):2273-5.

14. Thoolen B, De Ridder D, Bensing J, et al. Effectiveness of a self-management intervention in patients with screen-detected type 2 diabetes. Diabetes Care 2007 Nov;30(11):2832-7. Epub 2007 Jul 31.

15. Vargas RB, Mangione CM, Asch S, et al. Can a chronic care model collaborative reduce heart disease risk in patients with diabetes? J Gen Intern Med 2007 Feb;22(2):215-22.

16. Saaddine JB, Cadwell B, Gregg EW, et al. Improvements in diabetes processes of care and intermediate outcomes: United States, 1988-2002.[see comment][summary for patients in Ann Intern Med. 2006 Apr 4;144(7):I12; PMID: 16585656]. Ann Intern Med 2006;144(7):465-74.

17. Mangione CM, Gerzoff RB, Williamson DF, et al. The association between quality of care and the intensity of diabetes disease management programs. Ann Intern Med 2006; 145: 107-16.

18. Shojania KG, Ranji SR, McDonald KM, et al. Effects of quality improvement strategies for type 2 diabetes on glycemic control. JAMA 2006;296: 427-40.

19. Deakin TA, McShane CE, Cade JE, Williams R. Group based training for self-management strategies in people with type 2 diabetes mellitus. Cochrane Database of Systematic Reviews 2005, Issue 2. Art. No.: CD003417. DOI: 10.1002/14651858.CD003417.pub2

20. Pettitt DJ, Okada Wollitzer A, et al. Decreasing the risk of diabetic retinopathy in a study of case management: the California Medi-Cal Type 2 Diabetes Study. Diabetes Care 2005 Dec;28(12):2819-22.

21. Norris SL, Lau J, Smith SJ, et al. Self-management education for adults with Type 2 diabetes. Diabetes Care 2002;25:1159-71.

22. Health Disparities Collaborative. Phase 2 Measures of Diabetes Population. Available at: See Appendix 1 at http://www.mendocinohre.org/hre/msp/SHARE_rfp_022504.pdf. Accessed November 9, 2011.

23. American Diabetes Association. Standards of medical care in diabetes—2007. Diabetes Care 2007;30(1):S4-S41.

Appendix A: ABC Patient Report Card

Name:
Joe Patient
123 Mailing address, 4 Tri-fold
Denver, CO 90765

Do you know your diabetes ABC numbers??
A is for A1C. This measures your average blood glucose (sugar) over the last 3 months.
B is for blood pressure. High blood pressure makes your heart work too hard.
C is for Cholesterol. Bad cholesterol, or LDL, builds up and clogs your blood vessels.
If you have diabetes, you are at high risk for heart attack, stroke, kidney disease and blindness. Heart disease is more likely to strike you—and at an earlier age—than someone without diabetes.
But, you can fight back; practicing good health behaviors will enable you to take control of the ABCs of diabetes and live a long and healthy life!
Here is your ABC report card:

	Most Recent Result	Previous Result
A1C Goal less than 7		
Blood Pressure Goal 130/80 or less		
Cholesterol Goal LDL less than 100		

To improve my diabetes I will:
☐ Make and keep more regular appointments
☐ Take my medications exactly as prescribed
☐ Improve my diet
☐ Exercise more regularly.

If you are not at goal on any of your ABCs you need to be seen every 2 months until you are at goal.
We will send this report card every 3 months to help you monitor your diabetes.
Please bring this form with you to your next visit.

Boletín de Calificaciones ABC

Nombre:

Joe Patient
123 Mailing address, 4 Tri-fold
Denver, CO 90765

¿Conoce usted sus cifras ABC de diabetes?

A. corresponde a A1C. Esta cifra indica su promedio de glucosa (azúcar) en la sangre durante los últimos 3 meses.

B. corresponde a la presión sanguínea (blood pressure). La presión sanguínea alta hace trabajar demasiado al corazón.

C. corresponde al colesterol. El colesterol malo, o LDL, se acumula y obstruye las arterias del corazón.

Si usted tiene diabetes, usted tiene mayor riesgo de sufrir un ataque al corazón, derrame cerebral, enfermedad del riñón y ceguera. Usted tiene más probabilidades de tener una enfermedad del corazón a una edad temprana que una persona que no tenga diabetes.

¡Pero usted puede combatir la diabetes! ¡Los buenos hábitos de salud le ayudarán a controlar las cifras ABC de diabetes y a vivir una vida más larga y saludable!

Aquí está su boletín de calificaciones ABC:

	Resultado más reciente	Resultado previo
A1C La meta es menos de 7		
B. Presión sanguínea La meta es 130/80 o menos		
Colesterol La meta de LDL es menos de 100		

Para combatir la diabetes, yo:

☐ Pediré citas e iré a las citas con el médico con más regularidad.
☐ Tomaré mis medicamentos exactamente como me los han recetado.
☐ Mejoraré mi dieta.
☐ Haré ejercicio con más regularidad.

Si usted no ha llegado a su meta en sus cifras ABC, necesita que lo veamos cada dos meses hasta que alcance su meta.

Le enviaremos este boletín de calificaciones cada tres meses para ayudarle a controlar la diabetes.

Por favor traiga este formulario con usted a su próxima consulta.

Appendix B: Diabetes Registry Database Fields and Screenshots
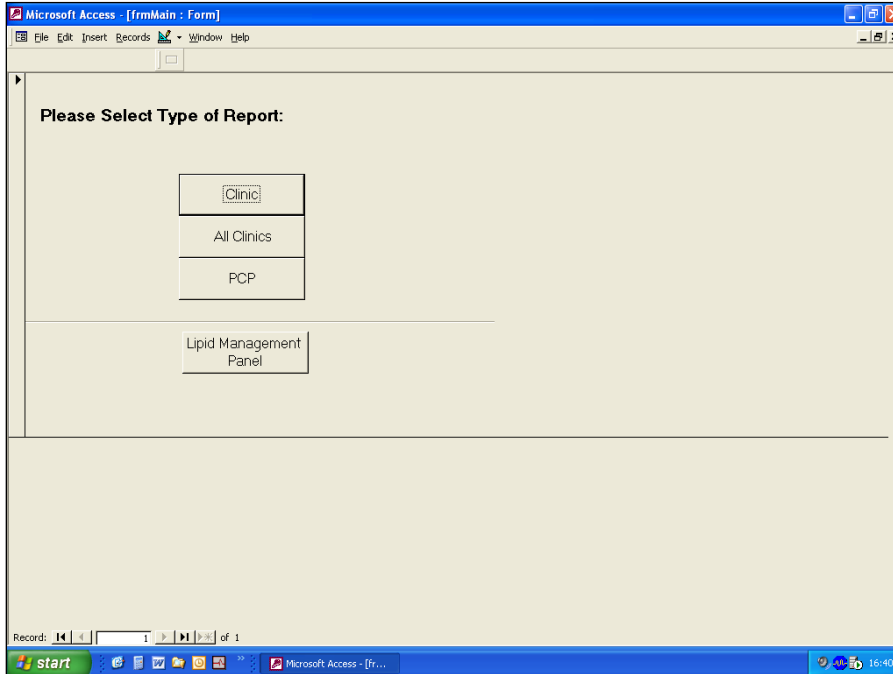
Diabetes Registry Database Field List

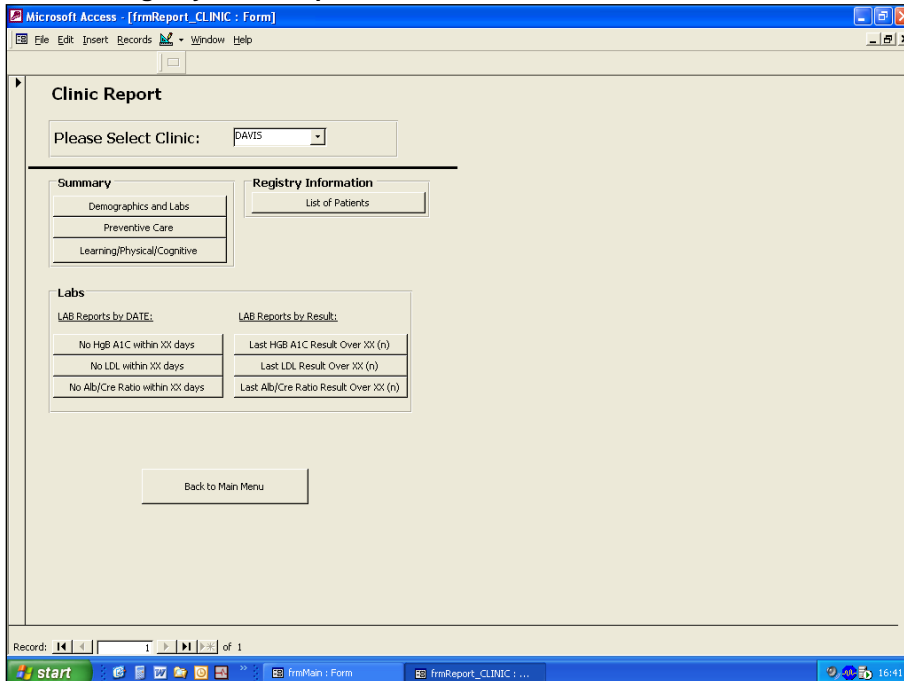| Field name in DM Registry	Description	Where data is pulled from
ACE/ARB	Is pt on ACE/ARB	Yes/No qst collected at "Encounter visit"
ASA/Other	Is pt on ASA/Other	Yes/No qst collected at "Encounter visit"
BMI	BMI measurement	Collected through "Encounter visit"
BP_DIASTOLIC	Blood Pressure Diastolic measurement	Collected through "Encounter visit"
BP_SYSTOLIC	Blood Pressure Systolic measurement	Collected through "Encounter visit"
DENTAL_EX	Date of exam	Collected through "Encounter visit" and from visits that have HOSP SVC CODE of "DHY", "DEN", "EDE", and "WDE".
EYE_EX	Date of exam	Collected through "Encounter visit" and from visits that have HOSP SVC CODE of "EYE", "EYG", and "EYR".
FLU	Date of shot	Collected through Vax Trax
FLU_RU	Shot refused/unknown	Collected through Vax Trax
FOOT_EX	Date of exam	Collected through "Encounter visit" and from visits that have HOSP SVC CODE of "EYE", "EYG", and "EYR".
HEARING	Pt hearing status	Collected through "Encounter visit"
HEARING_WNL	Pt hearing status	Collected through "Encounter visit"
HEIGHT_CENT	Pt height in Centimeters	Collected through "Encounter visit"
HEIGHT_FEET	Pt height in Feet	Collected through "Encounter visit"
HEIGHT_IN	Pt height inches	Collected through "Encounter visit"
HEIGHT_TOT_IN	Pt height total inches	Collected through "Encounter visit"
LATEX_ALL	Does pt have latex allergy	Yes/No qst collected at "Encounter visit"
MED_ALL_VER	Med allergies verified	Yes/No qst collected at "Encounter visit"
MEDS	Meds	Yes/No qst collected at "Encounter visit"
NARCOTIC_CON	Narcotic Contract	Yes/No qst collected at "Encounter visit"
O2	If the patient is on oxygen, how many liters	Collected through "Encounter visit"
PHQ9	Depression scale score	Collected through "Encounter visit"
PRIMARY_LANG_CODE	Primary Language code	Collected through "Encounter visit"
PULSE	Pulse	Collected through "Encounter visit"
PVAX	Date of PVAX	Collected through Vax Trax
PVAX_RU	PVAX refused/unknown	Collected through Vax Trax
RESPIRATION	Respiration	Collected through "Encounter visit"
SELF_MAN_GOAL	Pt's Self management goal	Collected through "Encounter visit"
SITE	Site of visit	Collected through "Encounter visit"
STATINS	Is pt on Statins	Yes/No qst collected at "Encounter visit"
STEROID_MDI	Is pt on Steroid MDI	Yes/No qst collected at "Encounter visit"
TD	Date of TD	Collected through Vax Trax
TD_RU	TD refused/unknown	Collected through Vax Trax
TEMP_C	Pt temperature in Celsius	Collected through "Encounter visit"
TEMP_F	Pt temperature in Fahrenheit	Collected through "Encounter visit"
TEMP_METH	Method used to collect temperature	Collected through "Encounter visit"
TOBACCO	Pt's tobacco use history	Collected through "Encounter visit"
VISION	Pt vision status	Collected through "Encounter visit"
VISION_WNL	Pt vision status	Collected through "Encounter visit"
WEIGHT_KILO	Pt weight in kilograms	Collected through "Encounter visit"
WEIGHT_LB	Pt weight in pounds	Collected through "Encounter visit"
WEIGHT_OZ	Pt weight in Ounces	Collected through "Encounter visit"
Protein, Urine, UPR	Lab Test	Collected by Lab
ALBUMIN/CREATININE RATIO, ALBCT	Lab Test	Collected by Lab
ALT	Lab Test	Collected by Lab
AST	Lab Test	Collected by Lab
CHOLESTEROL LEVEL	Lab Test	Collected by Lab
CREATINE KINASE MB	Lab Test	Collected by Lab
Hgb A1C	Lab Test	Collected by Lab
HDL Cholesterol	Lab Test	Collected by Lab
LDL, Calculated	Lab Test	Collected by Lab
Triglyceride, TRIG	Lab Test	Collected by Lab

Diabetes Registry Database Screenshots

Diabetes Registry Main Menu Screen

Diabetes Registry Clinic Report Selection Screen

Diabetes Registry All Clinics Report Selection Screen

Diabetes Registry Primary Care Provider Report Selection Screen

B-3

Appendix C: Data Warehouse

Denver Health and Hospital Authority
Data Warehouse Overview
May 16, 2007
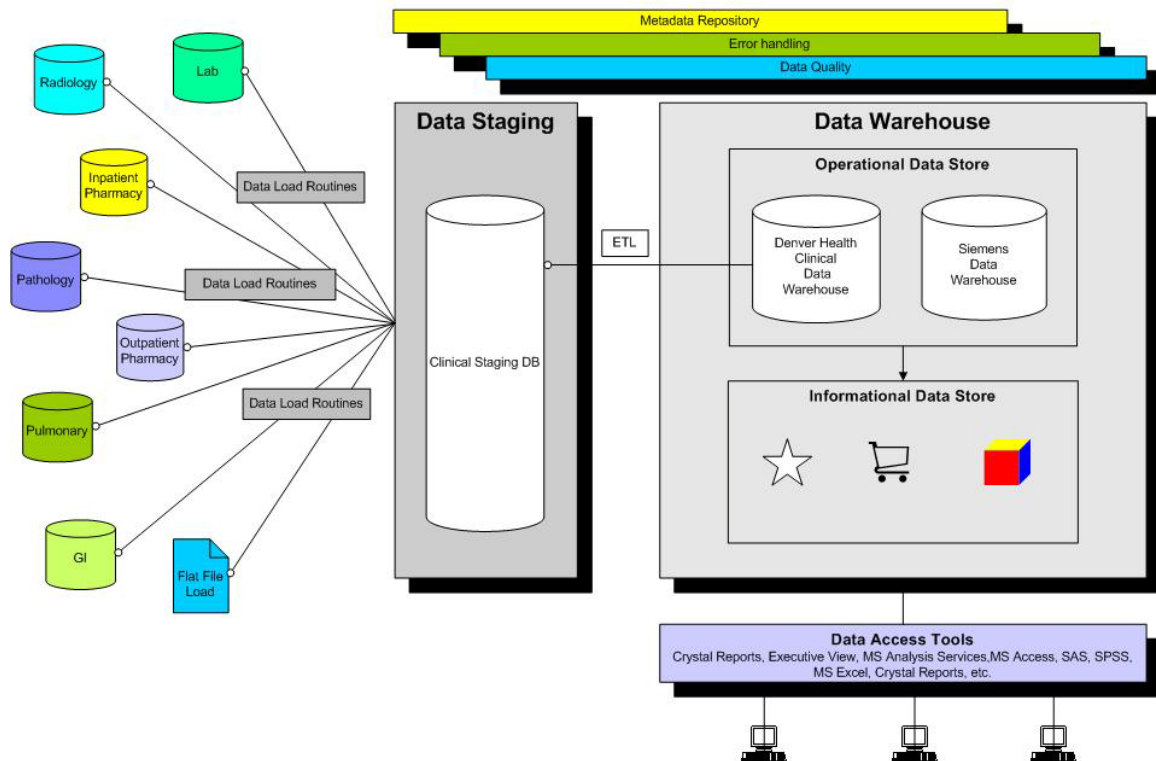
Appendix D: Patient Report Card Surveys

Dear Participant:

Please do not send any personal information (name, address, report card, etc) along with this filled out survey.

Recently, Denver Health began sending "ABC Report Cards" to help patients manage their diabetes. By now, you should have received at least one report card in the mail.

You have been randomly selected from a group of Denver Health diabetes patients to give your opinion about the ABC Report Card. The information you provide will help us to make the report card better and more useful for you. There are no right or wrong answers, so please let us know what you think. Your opinion is very important to us.

Please take the time to complete the following survey. All responses will be treated confidentially. You can return the survey to us in the enclosed postage-paid, preaddressed envelope.

Thank you for your help.

DENVER HEALTH
Level One Care for ALL

ABC REPORT CARD PATIENT SATISFACTION SURVEY

1. How many report cards have you received (including this one)?................._____

Please circle your answer to each of the following questions.

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
2a.	The report card was clear and easy to understand.	1	2	3	4	5
2b.	The information on the report card was correct.	1	2	3	4	5
2c.	The information on the report card was helpful.	1	2	3	4	5
2d.	I would like to keep receiving report cards.	1	2	3	4	5

3a. Did you take the report card to your health care provider?................YES   NO

Please circle your answer to each of the following questions.

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
3b.	My health care provider helped me understand the report card.	1	2	3	4	5
3c.	My health care provider helped me use the report card.	1	2	3	4	5
3d.	My health care provider should take more time to review my report card with me.	1	2	3	4	5

3e.　　If you did not take the report card to your health care provider, why not?

_____

_____

Please circle your answer to each of the following questions.

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
4a.	The report card helped me set goals to improve my diabetes.	1	2	3	4	5
4b.	My diabetes has gotten better since receiving report cards.	1	2	3	4	5
4c.	I can control my diabetes.	1	2	3	4	5

5.　　Do you have any other comments or suggestions about how we could make the report card better?

_____

_____

_____

_____

_____

_____

Thank you for your participation!

Please put the survey in the postage-paid, preaddressed envelope and drop it in the mail.

Estimado/a Participante:

Por favor, no envíe ninguna información personal (nombre, dirección, boletín de calificaciones, etc.) junto con esta encuesta una vez la haya llenado.

Recientemente, Denver Health empezó a enviar "Boletines de Calificaciones ABC" para ayudar a los pacientes a controlar la diabetes. Usted ya debe de haber recibido por lo menos un boletín de calificaciones por correo.

Usted ha sido seleccionado al azar de un grupo de pacientes de diabetes de Denver Health para que nos dé su opinión sobre el Boletín de Calificaciones ABC. La información que usted nos proporcione nos ayudará a hacer que el boletín de calificaciones sea más útil para usted. No hay respuestas correctas ni incorrectas. Simplemente indíquenos lo que usted piensa. Su opinión es muy importante para nosotros.

Por favor tómese el tiempo para completar la siguiente encuesta. Todas las respuestas serán confidenciales. Puede devolvernos la encuesta en el sobre con dirección y sello prepagado que le adjuntamos.

Gracias por su ayuda.

DENVER HEALTH
Level One Care for ALL

ENCUESTA DE SATISFACCIÓN DEL PACIENTE CON RESPECTO AL BOLETÍN DE CALIFICACIONES ABC

1.　　¿Cuántos boletines de calificaciones ha recibido usted (incluyendo éste)? _____

Indique con un círculo su respuesta a cada una de las siguientes preguntas.

		Muy de acuerdo	De acuerdo	Neutral	En desacuerdo	Muy en desacuerdo
2a.	El boletín de calificaciones era claro y fácil de comprender.	1	2	3	4	5
2b.	La información en el boletín de calificaciones era correcta.	1	2	3	4	5
2c.	La información en el boletín de calificaciones era útil.	1	2	3	4	5
2d.	Me gustaría seguir recibiendo boletines de calificaciones.	1	2	3	4	5

3a.   ¿Llevó usted su boletín de calificaciones a su proveedor de atención médica? SÍ NO

Indique con un círculo su respuesta a cada una de las siguientes preguntas.

		Muy de acuerdo	De acuerdo	Neutral	En desacuerdo	Muy en desacuerdo
3b.	Mi proveedor de atención médica me ayudó a comprender mi boletín de calificaciones.	1	2	3	4	5
3c.	Mi proveedor de atención médica me ayudó a usar el boletín de calificaciones.	1	2	3	4	5
3d.	Mi proveedor de atención médica debe dedicar más tiempo a revisar conmigo mi boletín de calificaciones.	1	2	3	4	5

3e.   Si usted no llevó el boletín de calificaciones a su proveedor de atención médica, ¿por qué no lo hizo?
_____
_____
_____

Indique con un círculo su respuesta a cada una de las siguientes preguntas.

		Muy de acuerdo	De acuerdo	Neutral	En desacuerdo	Muy en desacuerdo
4a.	El boletín de calificaciones me ayudó a fijar metas para mejorar la diabetes.	1	2	3	4	5
4b.	Estoy mejor de la diabetes desde que recibo los boletines de calificaciones.	1	2	3	4	5
4c.	Puedo controlar la diabetes.	1	2	3	4	5

5.   ¿Tiene usted otros comentarios o sugerencias sobre cómo podríamos mejorar el boletín de calificaciones?
_____
_____
_____
_____
_____

¡Gracias por su participación!
Por favor, ponga la encuesta en el sobre con dirección y sello prepagado, y deposítelo en el buzón.

Appendix E: Provider Interview Guide

Methodology: The interview guide format seeks to both ensure that specific items of interest are covered in the interview while also allowing the opportunity to obtain rich data through open-ended exploration of developed topics.

Question: How long have you been treating diabetes patients?

Intent: Addresses history/background/qualifications of provider.

Question: What are some of the ways in which you go about helping patients to manage their diabetes?

Intent: Examines treatment methodology and provider involvement.

Question: What are some methods your clinic used in 2008 to try to improve diabetes care?

Intent: Examines concomitant diabetes QI efforts around Denver Health during the AHRQ study.

Question: How can providers and Denver Health help diabetic patients improve intermediate outcomes (A1c, lipids, BP)? Or, what kind of chronic disease management programs will have the most impact for diabetics at Denver Health?

Intent: Explores provider attitude toward disease management strategies (e.g., Is there buy-in to the efficacy of provider and patient feedback).

Provider Report Cards

Question: How would you describe the "provider report card" program? (Probe: ask about card content, format, and delivery method).

Intent: Examines provider perception of cards; also identifies standard (control) v. enhanced (intervention) group.

Question: Do you use the provider report cards in any particular way? Also, for enhanced report cards, does patient specific feedback (e.g., lists of patients not at goal) help you manage your panel?

Intent: Nonconfrontational assessment of provider perception of card utility.

Question: How effective do you think the provider report cards are?

Intent: Seeks to elicit judgment of card program and/or insight into problems.

Question: Is there anything that you think would make the cards better?

Intent: Seeks to develop recommendations for card program improvement.

Patient ABC Report Cards (all providers may have come across these through the mailings; providers where the cards were printed on-site at registration will be very familiar with them—Eastside, La Casa, Montbello, Park Hill).

Question: How would you describe the patient ABC report card?

Intent: Examines provider perception of cards.

Question: Do you use the patient report cards in any particular way?

Intent: Nonconfrontational assessment of provider perception of card utility.

Question: How effective do you think the patient report cards are?

Intent: Seeks to elicit judgment of card program and/or insight into problems.

Question: Is there anything that you think would make the cards better?

Intent: Seeks to develop recommendations for card program improvement.